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FUTURE REQUIREMENTS OF CENTRAL STATIONS.

Prophecy after the fact is somewhat dangerous, but Mr. Torchio in his Atlantic City paper dealing with future conditions in central stations, has conservatively confined his forecasts to a period within relatively easy reach. He brings out some extremely interesting facts, especially with respect to probable improvements in load factor as based on present practice. It is somewhat startling to realize that in a great system like that of the New York Edison Company, 97 per cent of the total yearly output is produced by 50 per cent of the total generating apparatus, while the remaining 50 per cent is necessary merely on account of peak loads amounting to but 3 per cent of the annual output. The general public is very slow to realize the burden which these peak loads put upon the central station, and the consequent reasonableness of systems of charging which take account of the severe requirements of this peak service. The improvement in the general load factors for this same company, as tabulated by Mr. Torchio, is discouraging, and indicates very plainly the direction which active efforts should take in the near future to improve so bad a condition. In a large way this is the basis of Mr. Torchio's most important forecast, which is the organization of combination systems involving perhaps water-power, steam and gas engines with accumulators, so as to decrease the cost of power during the peak and to facilitate operation under more efficient conditions. One interesting bit of prophecy is the suggestion that gas engines with producer gas may become important factors in large central-station work. Though the smaller central stations now generally recognize the value of such plants, they appear to be looked at askance by the larger central stations. Nevertheless, they present excellent possibilities in the way of stored energy as an aid in carrying the peak and cannot longer be put aside without serious consideration. The steam accumulator to serve a similar function has not been so thoroughly tried, although Mr. Torchio speaks of it encouragingly, as he also does of considerably increased storage-battery installations for the same object. It would have been most interesting had he been able to give us, so far as could be ascertained from present data, a comparison based on cost between a given storage capacity for use during the peak as obtained by accumulated steam and accumulated electricity.

THE ACCOUNTING DEPARTMENT.

While the first separate accounting program was presented at the 1908 convention of the National Electric Light Association, the accounting department, by holding separate sessions, assumed more importance in the proceedings this year than last. This is apparently due in part to the realization by company officials of a need for better accounting methods and in part to the conditions which have arisen as a result of the greater participation of State commissions and other public authorities in corporate affairs. The central-station accounting department should be placed on a plane in accordance with the importance of its

functions; and in view of the increasing understanding of this fact, it is not surprising that discussion has already been started concerning the advisability of creating a distinct section of the association to consider the problems that arise, not only in office accounting management, but also in the public relations which recent laws and the attitude of investors and consumers promise for the future. Why the work of the men especially concerned in the accounting department has not always received in the past the recognition which it deserves may be ascribed to one or more of several reasons. Undoubtedly, the management of many companies failed to comprehend in the early history of the industry the fundamental principles of accounting and the importance of their practical application. The average general manager is interested chiefly in the departments which produce direct revenue. This is not an unnatural trait of humanity because one of the simplest facts of life is that without gross revenue, no business or no individual can be maintained. With gross revenue obtained, it then becomes a question of proper regulation of expenditures and the preservation of a surplus above expenses and interest on the investment. But those who look beyond the success which gross revenue appears to assure, understand the necessity for equally close study of the expenditures and the methods of accounting therefor.

Although it should no longer be countenanced, the practice of figuring gross revenue, calculating the necessary outgo and assuming that the balance is profit, is still followed. Like everything else in this world, accounting, after all, is governed by common sense. Yet accounting methods may be so lax that no information will be available to indicate the real standing of a property. It is, of course, due to stockholders and bondholders of enterprises that no statement of accounts should be rendered that is not as nearly perfect as a management of integrity can make it. While many questions that arise in the accounting work of a large corporation are for the executives or board of directors to determine, it may be found to be the fact that these men are misled by the statements presented to them. It is for the accountant to explain the meaning of the figures which he arrays. If the management is informed that an apparent showing of net earnings is not a true statement because of a failure to take into account a liability for depreciation, it will have information of a character which, although vital, was not appreciated by some companies in the early years of the electrical industry. If any proof were needed of the importance of the accountant in electrical properties, it would be furnished by the articles which have appeared recently in these columns regarding the accounting systems prescribed for public utilities of Wisconsin and New York, and particularly by the article in last week's issue discussing the merits of the classification prescribed by the New York commission.

If the commissions assume control over the issue of securities and questions of service and rates, their action on every vital aspect of these topics must find its justification or the reason for its rejection in a final analysis of the accounts. If these have been kept in accordance with the prescribed system or follow correct and approved methods, they provide evidence that is incontrovertible. Whether the authority of the accounting department is great, as it should be, or is seriously abridged as is unfortunately still the case in many properties, no company that is in touch with the movement for regulation which has attained such power can afford to neglect to effect reformation that will place it in step with the new standard of corporate integrity.

The Efficiency of Asynchronous Machines by the Hopkinson Method.

The great advantage of the Hopkinson method of testing direct-current generators and motors is that it operates them under rated-load conditions, without having to waste the actual power. If a direct-current generator of one megawatt capacity (1000 kw) is tested alone, under conditions of rated load, the full megawatt has to be absorbed, somehow, in machines or dead resistance, and the full energy plus losses have to be supplied to the generator shaft from a prime-mover. The same conditions apply to a direct-current motor of one megawatt under the modifications pertaining thereto. But if the megawatt generator be coupled mechanically and also connected electrically to the megawatt motor, the combination machine can be run under rated-load conditions, but with only the losses, or, say, 100 kw, supplied to the system from an external source. The generator will give its rated megawatt at terminals, and the motor will take this megawatt at its terminals, while a relatively small machine will serve to drive the pair. This is the well-known Hopkinson method. It requires the use of two similar machines. When only one machine has to be tested it is necessary to fall back upon test by losses, or else a full input-output test. The Hopkinson method was originally designed and published by its inventor in connection with direct-current shunt machines. It has since been extended both to synchronous alternators and to transformers, by Hopkinson himself. It has likewise been extended by others to direct-current series machines, and to synchronous alternating-current machines. An excellent article on its application to synchronous induction machines is contributed by Mr. Stanley P. Smith, this week, on page 1533. The article deserves careful reading, as an interesting extension of the Behrend circle diagram of the induction machine to the particular case of a pair of like machines mechanically and electrically coupled.

The article develops the circular diagram of the test as a mere ladder to the details of the method resulting therefrom. After this method has been reached, the ladder is dispensed with, and the test on a pair of coupled induction machines may safely be conducted without preparation of, or reference to, such a diagram. The two machines are electrically connected on the primary sides to each other and to the supply mains. They are also coupled asynchronously—i.e., by a belt driven over a pair of pulleys having slightly unequal diameters. Power given to the motor is measured, as well as that yielded by the generator, and that consumed in the generator external secondary circuits. From these data, after correcting for belt losses, the efficiency of each machine is very easily computed. Incidentally, it may be noted that the method offers an excellent opportunity for determining belt losses at different loads. It is pointed out in the article that there is always a small slip in even the best regulated belt. Only a sprocket-chain is slipless, and that has troubles of its own. Ordinarily, electrical engineers are accustomed to measure belt losses under no-load conditions, and then to assume, with grateful complacency,

that these belt losses are practically the same under all loads. Bending power and windage may be nearly constant under all loads; but a steadily increasing loss in friction, both internal and against the driving pulley, occurs in the belt as the load comes on. The methods indicated in the article seem to lend themselves very well to the measurement of such load losses in belts, and there is room here for a large engineering research.

On the other hand, it is true that the belt-loss test could be carried on by the aid of the Hopkinson method on synchronous machines, say, direct-current shunt machines, provided that the difference in the speeds of generator and motor is measured with sufficient care. Either a differential mechanical arrangement might be used, or a stroboscopic fork could be employed. A stroboscopic fork, when used to measure with precision the speed of a pair of belt-connected machines, indicates that the speed of the driven machine is less nearly uniform than that of the driver. The speed of the driving machine, if operated on a storage battery, may be practically uniform, whereas the speed of the driven machine, if it carries load, is seen to be not only slightly less than that of the driver, but also tremulous, due to the repeated slipping and gripping of the belt. This tremulousness may naturally be greatly increased by slackening the belt, but it exists usually to a clearly perceptible extent even with the tightest belts.

THE USE OF REACTANCE COILS IN GENERATING STATIONS.

When alternators were first employed industrially it was found they had so much internal inductance that not only was their automatic regulation of terminal voltage much poorer than that of direct-current generators under working conditions, but also their short-circuit current was only about twice their rated load current. Since the advent of steam turbo-alternators this condition of affairs has changed to some extent. The standard frequency of alternation has lowered, while the inductance of the machines has also lowered. The result is that the reactance of the machines has lowered doubly. This is an advantage so far as it goes, because it reduces the reactive drop of voltage in the armature and improves the regulation of the machines. On the other hand, it brings about a correspondingly more powerful short-circuit current if the machines are accidentally short-circuited at their terminals. An alternator is found to possess two kinds of reactance—namely, (1) the simple reactance of self-inductance, and (2) synchronous reactance, which consists of (1) plus the effects of armature reaction, or the demagnetizing influence of its active armature ampere-turns. The synchronous reactance of a modern alternator may be 20 times its self-induction reactance. When a short-circuit occurs suddenly, it is only the self-induction reactance that counts for the first second or so, after which the machine adapts itself to the new condition and the synchronous reactance reasserts its full value. Consequently, a sudden short-circuit at armature terminals may mean a momentary current strength and a torque perhaps 50 times the normal.

The above facts were presented to the recent N. E. L. A. convention in a brief paper by Mr. P. Junkersfeld. The suggestion is made therein that in some cases choking coils should be used in the armature circuits of large alternators to limit short-circuit current and power, as they are used in particular plants already. The objection to these choking coils is their large size, clumsiness, and detrimental effect on the regulation and efficiency of the system. It is much to be hoped that they may not have to be used extensively. If automatic circuit-breakers are inserted in concrete at the base of each alternator all short-circuits in cables to the switchboard should be rendered incapable of destroying the machine.

THE DAMPING OF OSCILLATIONS BY THE RESISTANCE OF THE AIR.

In a great variety of electric apparatus, and especially in measuring apparatus, we have suspended systems that are deflected from their initial positions by electromagnetic forces, their motions being checked, either in whole or in part, by the frictional resistance of the air. It is commonly assumed that this frictional resistance is simply proportional to the angular velocity of the motion. The working theory of galvanometers in general, and of ballistic galvanometers in particular, is based on this assumption. One consequence of this assumption is that the ratio of successive swings should be constant, and that the period of swing should also be constant. In a paper recently published by the American Academy of Arts and Sciences, Prof. B. O. Peirce gives the results of a number of photographic records of the oscillations of suspended systems moving in air. It is shown, in the paper, that the behavior of a swinging system is much more complex than is ordinarily supposed. Strictly speaking neither the ratio of successive swings nor the periodic time remains constant.

To fix ideas we may consider the case of a metal globe suspended in draught-free air by a thin torsion wire, and suppose that after the globe has come to a steady position of equilibrium, we start it swinging by a simple impulse of deflection. It is known that if the air were a perfect fluid, without viscocity, the air would offer no resistance to the motion. The air is, however, an imperfect fluid, and possesses viscosity. A certain layer thickness of air adheres to the globe, and swings to and fro with it. The globe behaves then not only as a body whose movement is retarded and whose energy of torsional displacement is gradually given off as heat in the surrounding air, but also as a body whose mass and moment of inertia are virtually increased by the adhering layer of air accompanying the motion. The amount of the increase in mass will vary with the surface character of the globe and also with the speed of the swing. It will be different in long swings at the outset of the motion from that which accompanies very short swings near the end.

If we now substitute for the globe a system of more complex geometrical form, such as a magnetic needle and attached mica vane, the same general conditions apply; but with yet greater complexity. If we suddenly deflect such a needle by an electromagnetic impulse, a system of air particles is built up, mainly during the first swing, so that the behavior during this swing may be very different from that during subsequent swings, when the moving air system has settled down into substantial regularity of form. Consequently, the ordinary assumptions of ballistic galvanometer deflections, above referred to, may hold fairly well after one or two swings have been completed; but the initial impulse cannot safely be inferred from the observations made on subsequent swings. This deduction, arrived at in the paper, should be borne in mind by those who have occasion to use ballistic galvanometers.

Proposed Consolidation of Chicago Elevated Roads Abandoned.

Messrs. Samuel Insull, Ira M. Cobe and E. K. Boisot, constituting the committee having in charge the proposed leasing of all the elevated railroads in Chicago by a new company to be formed for the purpose, have issued a statement in which they say that they do not think it advisable to proceed further with the negotiations, for the present at least. The Northwestern and Oak Park roads were apparently willing to enter into the arrangement, and substantial progress had been made with the Metropolitan Company, but the South Side Company refused to accept the terms offered in the proposed consolidation, and negotiations with that company have been terminated. Inasmuch as the committee does not think it advisable to attempt unification of the elevated roads unless all of the lines are included, the project has been dropped.

Supplementary Report on Chicago Subways.

The final report of the Subway Bureau of the city of Chicago, supplementing the elaborate preliminary report abstracted in the issue of April 1, 1909, has been made public. The report contains four sets of plans for subways for street railways in the central downtown district of Chicago, ranging in estimated cost from $100,000,000 to $112,000,000. Each of the plans is so arranged that it may be made to include, besides the subway itself, galleries for public utilities. The plan which appears to meet with most favor provides for the construction of six through routes. Two of these will connect the North Side and South Side, two the North Side and West Side and the others the South Side and West Side. This plan also contemplates a so-called "depot loop"—a subway which will run around the heart of the city in close proximity to nearly all of the railroad stations. The plans provide for a seating capacity of about 500,000 passengers in the subways. This capacity should provide for the growth of the population of Chicago, at the present rate of increase, until the year 1932. Including standing room, the system will not reach its ultimate maximum capacity until 1950. The plans are not worked out in detail, and as it will be some time before an actual decision is reached in the matter of constructing street-railway subways in Chicago, the proposals are largely tentative in form.

Power Development on Proposed Waterway from Lakes to Gulf.

In a report to Congress from the War Department on the subject of the proposed ship channel from Lake Michigan to the Gulf of Mexico by way of the Chicago Drainage Canal, Illinois River and Mississippi River, a board of army engineers estimates that it will cost $128,600,000 to construct a 14-ft. channel from St. Louis to the mouth of the Mississippi without making an estimate of the remaining part of the route. A waterway 8 ft. or 9 ft. deep is recommended as much more practicable. The board goes into the question of the development of water-power along the channel, particularly in Illinois. It considers that the property owners along the Drainage Canal and the Illinois River are equitably entitled to water-power due to the natural flow alone of the Desplaines and Illinois rivers, and holds that any added power which results from water diverted from Lake Michigan belongs to the people of the United States and Canada.

The army engineers who have studied the subject do not agree in relation to it, however. The board of review, for instance, does not concur in the views of the survey board in relation to ownership by the people of the United States and Canada of the power resulting from the water from Lake Michigan. This board suggests that this matter and also the subject of compensation are subjects for judicial determination, and says: "Should it be determined that the United States owns any water used in the development of water-power, any Government charge made for such use should commence with such use, and should not be deferred until the cost of the plan by which such use is made possible shall have been collected from consumers of the power. Compensation, if any, should be fixed by Congress." It is estimated that 100,000 hp can be developed by the diversion of 10,000 cu. ft. per second. This power is estimated to be worth $2,500,000 a year.

The advocates of the deep waterway are not satisfied with the report, which they say is not only a blow at the project itself, but to water-power development as well. Those who have been opposing the proposal say that the findings of the engineers will have great weight with Congress against the feasibility of the project.

Northwest Electric Light and Power Association.

The Northwest Electric Light and Power Association, recently formed "to foster and protect the interests of those engaged in the commercial production of electricity for conversion into light, power and heat," will hold its first convention Sept. 7, 8 and 9, in the Auditorium Building of the Alaska-Yukon-Pacific Exposition in connection with a district convention of the American Institute of Electrical Engineers. The association has fitted up space in Machinery Hall for the convenience of electrical men visiting the exposition, and has established an information bureau which among its duties arranges for the reservation of accommodation in hotels and private families for electrical visitors.

Membership in the association is confined to Washington, Oregon, Idaho, Montana and Alaska. There are five classes of members, namely: A, private electric lighting companies; B, invited members; C, associate member companies; D, associate members, and E, honorary members. Class B, or invited members, are confined to officers and employees of member companies, elected yearly upon the written recommendation of their respective companies. The officers of the association are as follows: President, Mr. Arthur Gunn; vice-presidents, Messrs. A. Welch, Francis Rotch and Henry Adams; secretary, Mr. Norwood W. Brockett, Cataract Building, Seattle, Wash.

Meeting of National Gas and Gasoline Trades Association.

The National Gas and Gasoline Engine Trades Association will hold a meeting, June 22, 23 and 24, at South Bend, Ind. This association was organized some months ago to advance the interests of the gas and gasoline engine trade, and to promote an acquaintanceship among all those interested in the internal combustion engine. Among the papers to be presented at the meeting are the following: "The Suction Gas Producer for Small Power Plants," by Mr. C. J. Atkinson; "Storage Batteries for Ignition Purposes," by Mr. G. L. Chandler; "A Running Test of a Gas Engine, With Data," by Mr. J. C. Miller; "Water, Its Uses and Abuses in Relation to Gas Engines," by Mr. H. W. Jones; "Gas Engine Construction for Producer Gas Use," by Mr. H. L. Smith; "Science of the Jump Spark Coil," by Mr. J. A. Williams.

There will be opportunity at the Oliver Hotel for the display by manufacturers or dealers of small accessory articles which will not be too bulky to place on tables in the meeting room. An invitation has been extended to the American Gas Power Society and the Gas and Gasoline Engine Manufacturers' Association to attend the meeting. By way of entertainment there will be a trolley ride from South Bend to St. Joseph, Mich., and return. The local Chamber of Commerce has also arranged for an automobile ride and inspection of the factories of the Studebaker Manufacturing Company and the South Bend Watch Company.

Hydro-Electric Development in Sicily.

A paper presented recently before the Italian Electrotechnical Association by Sig. E. Vismaro gives details of a broad scheme of hydro-electric development for the Island of Sicily. The author, who is general manager of the Societa Elettrica della Sicilia Orientale, gives the result of a thorough study of the watersheds and geological formation of Sicily, and arrives at the conclusion that by means of artificial lakes or storage basins the entire island can be supplied with electrical energy generated in a series of hydro-electric plants working in parallel at 40,000 volts. Two generating stations are now being built by the above-mentioned company, one near Syracuse and the other near Taormina. When completed, the former station will contain four 2000-hp units and the latter three 2500-hp units, each unit consisting of a water-wheel direct-coupled to a 50-cycle, three-phase alternator. These two plants will supply the whole eastern coast of Sicily by feeding in parallel a 40,000-volt line extending from Modica to Messina. The distance between the two generating stations is about 72 miles.

Society of Automobile Engineers.

The Society of Automobile Engineers was incorporated last week under the laws of the State of New York. The object of the society is "to promote the arts and sciences connected with engineering and the mechanical construction of automobile vehicles; to hold meetings for the reading and discussion of papers relating to the construction and improvement of automobiles, and to promote social intercourse among its members; to publish and distribute papers and literature relating to the construction of automobiles, and to maintain an engineering library."

There are to be 12 directors and the principal office will be in New York. The incorporators are: Messrs. Russell Huff, of the Packard Motor Car Company, of Detroit, Mich.; Andrew L. Riker, of the Locomobile Company, Bridgeport, Conn.; Henri C. Chatau, of the General Electric Company, Schenectady, N. Y.; B. D. Gray, of the American Locomotive Works, Providence, R. I.; R. C. Carpenter, of Sibley College, Cornell University, Ithaca, N. Y.; Henry Hess, of Philadelphia; F. J. Newman, of Chicago; Alexander Churchward, Horace M. Swetland and Thomas J. Fay, New York.

Helena (Mont.) Hydro-Electric Plants.

Mr. A. C. Pratt, electrical engineer for the Missouri River Power Company, Helena, Mont., recently gave an interesting lecture before the electrical engineering students of the University of Minnesota on "Hydro-electric Plants." His company has in operation, or under construction, three dams in the Missouri River, having heights of 30 ft., 60 ft. and 110 ft., and making reservoirs of 4000 acres, 6000 acres and 7000 acres, respectively. The Missouri River has a minimum flow of about 3000 cu. ft. per second and the reservoirs created by the three dams provide storage capacity of about 21,000,000 hp-hours, which would maintain a steady load of 15,000 hp for more than a month. This makes the company safe in connecting with a load considerably larger than the minimum power of the river.

An interesting phenomenon is that the heat from the sun received in the winter and caught in the reservoirs keeps the water under the ice about 2 deg. above the freezing temperature. A practical point in transmission is to have the transformers for the receiving end of the line wound for a voltage about 15 per cent lower than that at the power house.

The most desirable kind of load in mining districts is given by motors for pumping and crushing. The hoists give a rapidly varying load similar to that of a street railway. Some hoists in the mines at Butte run up to 3000 hp, lifting cars weighing 6 to 12 tons, at a speed as high as 2500 ft. per minute.

Steam power for the mines at Butte costs about $95 per hp-year in large plants and about $300 in small plants. With power at $30 per horse-power per year land can be irrigated profitably, even pumping water to a height of 150 ft. Thus land costing $10 per acre can be made worth $100 per acre at a cost of $5 to $6 for pumping. The yearly evaporation in Montana is about 50 in.

The plant at Canyon Ferry has been in continuous operation since it was built in 1897, power being transmitted 20 miles to Helena and 65 miles to Butte. There are from six to eight short-circuits per year caused by lightning. The trouble from lightning always originates on the plains and never in the canyons. The trouble almost always comes on the topmost wire. About 70 per cent of the line troubles come from outside interference. The insulators on the line are supported by wooden pins boiled in paraffine at 115 deg. C. to 120 deg. C.

Railroad Men Study Electrification.

The New York Railroad Club has appointed a special committee to study the subject of steam railroad electrification, which will render a report of their work for consideration at the annual electrical meeting of the club next March. Following are the members appointed: Mr. W. J. Harahan, assistant to the president of the Erie, New York, chairman; Mr. L. F. Fritch, consulting engineer of the Illinois Central, Chicago; Mr. H. H. Vaughan, assistant to the vice-president of the Canadian Pacific, Montreal; Mr. J. H. Davis, electrical engineer Baltimore & Ohio, Baltimore; Mr. George Wildin, mechanical superintendent of the New York, New Haven & Hartford, New Haven; Messrs. William McClellan, C. O. Mailloux and H. M. Warren, electrical engineers, New York.

The committee is to collate and tabulate such general data as may be of interest to railroad men, and make such suggestions as may appear pertinent to them with reference to the direction in which it would be desirable to have further investigation and information. The Maintenance of Way Association and the American Railway Association are considering the subject of electrification along substantially the same lines, so that within a year there will be available a large collection of practical data on the subject.

A Novel Turbo-Generator Arrangement.

The Albert Lea (Minn.) Light & Power Company is installing a 300-kw Westinghouse steam turbine under rather unusual conditions. This plant has heretofore given only direct-current service. A hot-water heating system is also operated in connection with the plant. As it seemed desirable to put in an alternating-current distribution system for reaching the outskirts of the town with light and power service, the following arrangement of turbo-alternator and rotary converter is being installed:

The 300-kw alternator of the turbo-generator set is a low-voltage machine, the terminals of which are connected through the switchboard to the alternating-current terminals of a 200-kw rotary converter which gives 250 volts direct-current at its commutator. The turbo-generator and rotary converter can be started from a state of rest together. The low-voltage alternator on the turbine shaft will also supply step-up transformers giving 2300-volt, three-phase current for general distribution. This will make a very flexible combination, and one which it is believed will operate more satisfactorily as regards direct-current output than would a direct-current generator of sufficiently high speed to be mounted on the turbine shaft. The turbo-generator when in operation can supply alternating current to the alternating-current distribution system and also can feed into the direct-current distribution system through the medium of the rotary converter. When the turbo-generator is not running, direct current from the other generators in the plant will operate the rotary converter which can feed alternating current through the step-up transformers into the alternating-current distribution system. The steam turbine is to be operated condensing during the summer and in the winter will supply steam at atmospheric pressure to the hot-water heaters for the heating system.

British Illuminating Engineering Society.

As previously noted in these columns, at an inaugural dinner in London on Feb. 9 of this year, it was decided to form a British Illuminating Engineering Society, and an executive committee was appointed to consider the drafting of the constitution of the society, etc. This committee reported at a meeting of the supporters of the society held at St. Bride Foundation Institute, Bride Lane, London, E. C., on May 25, Mr. Charles Hastings being in the chair. The constitution and by-laws drafted by the committee were formally ratified by those present, and the executive committee, forming the nucleus of the first council of the society, was reappointed with the power of adding to its numbers as might be expedient in order that it might proceed with the affairs of the society during the summer vacation. It was also decided that this committee should approach a number of gentlemen, the names of whom were submitted to and approved by the meeting, with a view to their being invited to act as officers or on the council of the society. It was also agreed that the council should be free to elect as members any who intimated their desire to become members of the society, and were duly proposed and seconded in the prescribed manner, without the formality of ballot, up to the beginning of the first session of the society. Mr. L. Gaster, editor of the *Illuminating Engineer*, 32 Victoria Street, London, S. W., is honorary secretary of the society.

Cleveland Industrial Exposition.

The Cleveland Industrial Exposition, which opened on Monday evening of last week, has proved a success far beyond the expectations of the committee of the Chamber of Commerce which promoted it. Not only are the displays far more creditable than anticipated, but the attendance has exceeded expectations, running from 15,000 to 30,000 daily. Had the matter been taken up three months earlier, it is believed that there would have been a large attendance from many States. As it is, visitors from other cities are numerous. Boards of trade and chambers of commerce, as well as civic organizations of other kinds, in a number of cities have sent delegates to the exposition. Several representatives from foreign countries have also been in attendance for the purpose of learning what they could about the products offered in their markets.

The city was handsomely decorated for the occasion and lighting schemes played no small part in this. Lines of electric lamps extend around the Public Square and out both Superior and Euclid avenues to East Ninth Street on both sides. From Superior Avenue they lead down Bond Street to the exposition buildings. The lamps are placed about a foot apart and are connected directly with the lines stretched temporarily between the street lamp-posts. In the middle of the Public Square is a globe made of incandescent lamps, with lines radiating in several directions from it.

The lighting system in the temporary exposition building is also unique. This building has a tent covering, somewhat resembling a circus tent, and the lamps are arranged in what might be termed undulating or serpentine lines. The effect upon one on first entering the building from the balcony is striking. In the Central Armory Building, which contains the textile displays, arc lights are suspended from temporary wood frames attached to the roof beams. In addition incandescent lights are arranged about the building and among the displays in such a manner as to increase the lighting effect. Both buildings are well lighted, and this adds much to the beauty of the display.

Displays of interest to men engaged in the electrical business compare most favorably with those in other lines, both in number and taste in arrangement. Cleveland has grown more prominent during the past few years in the manufacture of electrical equipment and appliances than many other places, and bids fair to remain well abreast in this line in the future. Manufacturers of miscellaneous articles used in this line of work are well represented, also.

One of the handsomest booths in the exposition is that of the Cleveland Electric Illuminating Company. It is located in the Central Armory Building and takes up quite a little space. Extending above the framework that encloses the space is a sort of canopy made of vines and branches, among which are placed hundreds of incandescent lamps. This canopy extends well up to the roof of the building and the lighting effects may be seen from almost any part of it. The display consists of small household machines and appliances operated by electric power. In making the display the company sought only to call attention to the importance of using electric energy and the various uses to which it can be applied. It handles articles only until they are well introduced and makes a point of extending the use of energy thereby. This is the whole aim of all the advertising that is done, the policy of the company being to sell only its own output.

A complete telephone exchange, with two operators, is maintained by the Cleveland Telephone Company. All booths are furnished with telephones, so that direct communication may be had with any other point in the city, and with long-distance lines. The exchange is kept busy all the time. Photos of exteriors and interiors of the main and branch exchanges are shown, as well as a full line of instruments in use.

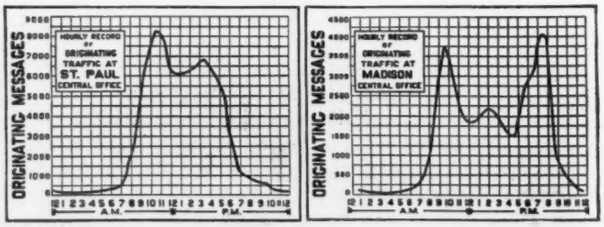
A handsome little booth is used by the Cleveland Engineering Society, which is maintained for the purpose of showing what the organization is for and what is being accomplished.

Descriptions of other exhibits will be found elsewhere in this issue.

Telephone Exchange Traffic Curves.

The Chesapeake & Potomac Telephone Company is conducting through the advertising pages of Baltimore newspapers an excellent campaign of public instruction as to telephone service, including business and operating methods, exchange organization and plant. The large announcements are tastefully designed and illustrated, and the text, while brief, is always to the point. As of general interest, the accompanying curves of exchange load are reproduced from one of the advertisements.

The text explains that in the business district served by the St. Paul exchange, 72 per cent of the day's traffic is handled between 10 a. m. and 4 p. m. Between 9:30 a. m. and 10:30 a. m. the business man answers his correspondence and con-



TELEPHONE EXCHANGE LOAD CURVES.

ducts the details of his business by telephone. The highest peak of the day is reached at 10:30 a. m. The number of messages drops at luncheon hour, and then immediately starts upward, reaching the afternoon peak at 3:30 p. m. The closing of the business day is readily determined by the chart. Newspaper office and hotel traffic prevent the evening curve from dropping suddenly. The curve of the Madison station, which is in a residence district, tells a different story. The greater part of the day's shopping and marketing is done between 9 and 10:30 o'clock in the morning. Following the drop at luncheon time is a rise representing the social messages of the women folk. It is remarkable that the highest peak of the day is reached at 7:30 p. m., showing the importance of the telephone in the preparation of the evening's entertainment. The curve given is for an average day; a storm shows instant effect on the amount of traffic and increases it in proportion to the severity of the weather.

Valuation of Indiana Telephone Properties.

According to the annual report of the Indiana State Tax Board just issued, telephone properties in the State showed a total valuation of $10,201,519 as against $10,572,987 for 1908. These companies are taxed on the valuation of their corporate property, the assessments being made on reports made to the board during the month of May each year. There is considerable speculation over the fact that the chief decreases were made in the property of the Central Union Telephone Company and the Cumberland Telephone Company, both Bell concerns, and that conspicuous increases occur in the values of the Independent telephone properties. The Indianapolis (Independent) Telephone Company's property is valued at $79,000 and the New Long-Distance (Independent) Telephone Company's property at $41,000, more than last year. The only increase in valuation assessed against the Bell property was $5,873 against the American Telephone Company and the only decrease of any material amount given to an Independent company was $20,480 in favor of the Citizens Telephone Company, of Fort Wayne, due to great loss by storm.

Detroit River Tunnel Electric Locomotive.

The first of six direct-current locomotives for the tunnel under the Detroit River has been finished, and the acceptance test completed. The locomotives are designed for hauling both freight and passenger trains through the tunnel, and also for switching service at the terminal. The tunnel will connect the Western Detroit yards of the Michigan Central Railroad and the new Windsor yards, Windsor, Ont., the electrified zone embracing the tunnel with its approaches, terminals, tracks and sidings extending over approximately 33,000 ft. The specifications demand a maximum service consisting in hauling an 1800-ton trailing train up a 2 per cent grade at a speed not less than 10 miles per hour, with two locomotives operating as multiple units; and the capacity must be such as to enable them to repeat the trips with this weight of train continuously with a lay-over of 15 minutes at each end, and without undue heating of the motors. The total weight of the locomotive is 199,000 lb.

The motor equipment consists of four 300-hp commutating-pole motors. The gearing between meter and axle has a 4.37

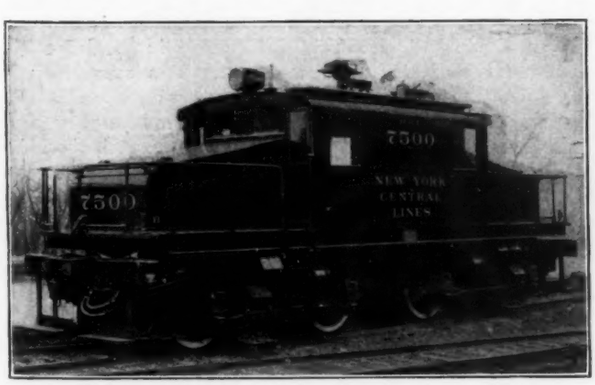


FIG. 1.—GENERAL VIEW OF DETROIT RIVER TUNNEL LOCOMOTIVE.

reduction, and the driving wheels are 48 in. in diameter. With this reduction each motor will develop a tractive effort of 9000 lb. at the rail head, which gives a total tractive effort for the four motors of 36,000 lb. at 12 miles per hour. The motors have an overload capacity sufficient to slip the driving wheels, and the locomotive can develop at the slipping point of the wheels an instantaneous tractive effort of 50,000 lb. to 60,000 lb. The maximum speed of the locomotive running light upon a level track is about 35 miles per hour.

There are two gears and pinions per motor, one at either end of the armature shaft. This construction was adopted on account of the unusually heavy torque and excessive overloads that the motors will be called upon to carry. In large sizes of motor equipments, with a gear and pinion at only one end of the shaft, it has been asserted that a large proportion of the wear and breakage of pinions is due to the tilting of the motors under heavy loads, which concentrates the pressure at one end of the tooth. The form of construction adopted in the Detroit locomotives will eliminate any such danger.

The motors are designed for forced ventilation. Air is delivered into the motor frames at the end farthest from the commutator, passes between the field coils and around the

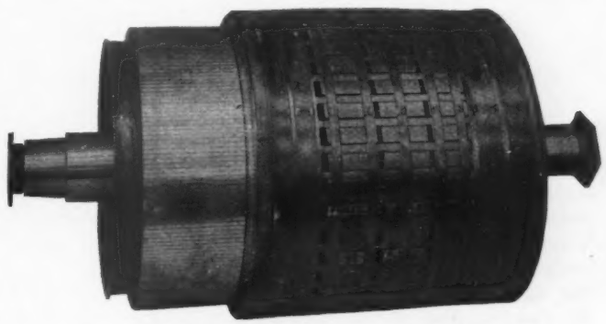


FIG. 2.—ARMATURE OF COMMUTATING POLE MOTOR.

armature, and finally escapes through suitable discharge openings over the commutator. The blower used for this purpose has a capacity of 2000 cu. ft. of air per minute of 2¼ in. of water pressure, and is driven by a direct-current series motor. This blower delivers air to the passage between the two center sills above described, from which the ventilating ducts are tapped off to the motors at appropriate points.

The control system used is the Sprague-General Electric multiple-unit type, with two master controllers in the main cab and the contactors in the auxiliary cab. Multiple-unit connections are fitted, so that three locomotives may be operated in unison if necessary. The problem of starting and accelerating a train of from 1000 tons to 1500 tons weight, which may consist of 40 or 50 cars, is a rather difficult one. Such a train is not a rigid mass, but a long elastic body, and any inequality in the starting torque results in waves of jerking and buffing strains which may reach abnormal values in some parts of the

FIG. 3.—FRAME OF MOTOR, SHOWING COMMUTATING FIELD COILS.

train. Consequently the control for these locomotives was designed especially to produce a uniform increase of speed and torque during the period of acceleration. The control combinations are so arranged that the motors may be operated four in series, two in series and two in parallel, or four in parallel. There are nine resistance steps in series, eight in series-parallel and seven in the parallel position. In a test run with a train of 1578 tons weight, consisting of one locomotive and 26 freight cars, the acceleration from a standstill to 10 miles per hour was accomplished with marked smoothness. The maximum increase of draw-bar pull was about 6500 lb. on the first few

steps, after which the maximum throughout the remainder of the acceleration was from 2000 lb. to 3000 lb. To an observer standing in the caboose of such a train, the rear end of the train is started so gradually that the beginning of the motion is almost imperceptible; the contrast with the results obtained with a steam locomotive is thus very striking. The locomotive is equipped with third-rail shoes to take current from an inverted third-rail. It is also fitted with an overhead trolley, which can be raised or lowered by a foot-operated valve in front of the motorman. The electrical part of the equipment was supplied by the General Electric Company, the locomotive having otherwise been built at the Schenectady works of the American Locomotive Company.

Commercial Development of Wireless Telegraphy.

Mr. Cloyd Marshall presented a paper at the June meeting of the New York Electrical Society, held at the Waldorf-Astoria on June 16, entitled "The Commercial Development of Wireless Telegraphy." After sketching the history of wireless telegraphy, which is dated from 1842, when Professor Morse sent signals across the Susquehanna River without wires, the fundamental principles of wireless transmission were simply explained. Referring to later developments, it is stated that in the plain aerial system the oscillations are heavily dampened, and that the system is also limited to the amount of energy which can be used, owing to the small capacity of the antenna. Consequently the close oscillating circuits have been brought into use, which consist of a condenser, a variable inductance and a spark gap, the condenser being charged from the secondary of a transformer or a large induction coil. As such a condenser can be made of any size, it is possible to use many times more energy than can be used with the plain aerial system. In the latter the capacity is as low as 0.00025, and never higher than 0.002 excepting in extremely large stations. On the other, capacities used in closed oscillating circuits range from 0.0075 to 0.01 and even higher. The condenser generally has a fixed value, and it is adjusted with the secondary of the transformer, which is closed to charge it. The variation of the frequency of the oscillations is caused by varying the amount of inductance in the closed oscillating circuit.

With instruments now in use, known as wave meters, it is possible in a few seconds to determine the exact frequency, as well as other characteristics, of the oscillating circuits, these instruments being called wave meters. Returning again to a comparison of the closed and open oscillating circuits, it was stated that while the former is capable of holding energy for a considerable time, and the oscillations produced by it are not nearly so heavily dampened as those produced by the plain aerial system, on the other hand, the closed circuit is a very poor radiator of energy, while the reverse is true of the plain aerial systems. Consequently the two systems have been combined, the closed oscillating circuit for the production of electrical oscillations, with the plain aerial or open circuit for the radiation of energy.

The following statistics were given as to the use of wireless telegraphy in the Government departments: The Bureau of Equipment of the Navy Department operates 56 land and shore stations in navy yards and in subject countries. The Army Signal Corps operates stations at the principal seaboard fortifications and in Alaska and the Philippine Islands. The Lighthouse Board maintains wireless stations on three of the lightships, the Treasury Department on 17 of the revenue cutters, the army on six of its cable ships and transports and the navy on the principal armored vessels. The United States Wireless Telegraph Company now maintains 277 stations on the Atlantic seaboard, 26 stations on the Pacific Coast and 7 on the Great Lakes. It also operates 163 stations on shipboard. The latest list of wireless equipments as compiled by the Bureau of Equipment of the Navy Department gives a total of 782 land and floating stations for the world.

A Swedish Radium Enterprise.

According to the London *Electrical Review*, it is announced from Stockholm that the preliminary notice has been locally registered for the formation of the Culm Company, which proposes, according to various inventions of Dr. G. Hellsing, to win uranium and radium from the mineral culm and other raw materials, and to dispose of patents and licenses. The minimum share capital has been fixed at 700,000 crowns and the maximum at 2,100,000 crowns.

The promoters of the company are Profs. J. G. Andersson, Svante A. Arrhenius and Sten, A. Hj. Sjogren, Dr. G. H. Hellsing and C. U. Waern, the names being said to be apparently a guarantee that the scheme rests upon a scientific basis. Professor Andersson is the manager of the State authority known as Sweden's Geological Investigation; Professor Arrhenius is the celebrated physicist and Nobel prize winner, and Professor Sjorgen is the superintendent of the Government Mineralogical Collections and successor to the discoverer of the North-Eastern passage. It appears that Professor Nordenskjold, Dr. Hellsing and other founders have for several years past investigated the mineral culm, which is a kind of impure pit coal existing in the Alaun schist, for the winning of uranium and oils. After it had been discovered abroad that most minerals embodying uranium also contain radium, the latter has likewise been discovered in culm, which exists in an inexhaustible quantity in the Swedish province of Vastergotland.

The promoters of the company have assured themselves of considerable fields in this province, one alone containing 100,000 tons of culm. As a result of previous experiments it has been found, it is stated, that 1 ton yields 4 mm of radium bromide, a combination which is said to be admirable for the market.

Cornell University Engineering Graduates

The forty-first annual commencement of Cornell University was held on Thursday, June 17. In the absence of President Schurman, degrees were conferred by Prof. T. F. Crane, who retires this year from the headship of the department of romance languages. More than 225 men received the degree of Mechanical Engineer, including about 75 who have specialized in electrical engineering.

Two years ago the electrical course was improved by the addition of a junior laboratory course. The present class is the first to graduate from this complete course—namely, eight hours of required electrical work weekly in the junior year and twenty hours in the senior year. This complete course comprises (1) a junior laboratory course with one experiment per week throughout the year; (2) a senior laboratory course with two experiments and one recitation per week throughout the year; (3) a junior recitation course on the elements of electrical engineering with two recitations per week throughout the year; (4) a senior recitation course on the theory of electric circuits and machines with two recitations per week throughout the year; and (5) a senior problem course with two computing periods per week throughout the year. In addition a number of elective courses were offered, one or more of which were taken by the electrical seniors. Last year these were: (1) design of electrical machinery; (2) electric-power generation and distribution; (3) telephone engineering; (4) wireless telegraphy; and (5) elementary and advanced electric railways.

The senior problems form the main portion of the course. They consist in the prediction of the performance of electric circuits and machines when the dimensions of the various parts and the properties of the materials are given. In order to make such calculations the student must be familiar with the theory and the operation of the electrical device studied. The solution of these problems prepares students also to take advantage of the advanced courses offered during the second term. By means of these courses he may follow out any particular inclination toward a special electrical subject. While these courses

are of a somewhat practical nature, the theory is not forgotten. The courses are not intended to fit students directly for practical work, but rather to show the application of electrical principles to particular fields.

The appointment of a permanent head for the department has permitted a rearrangement of the details. Beginning next fall there will be three main divisions of the department, each under the charge of a professor or assistant professor. The divisions are: (1) Introductory (junior) courses; (2) advanced laboratory courses; (3) advanced theoretical courses. In the junior year the same range will be covered as heretofore, but in somewhat different order. The first term work will comprise three recitations and one illustrated lecture per week. In the second term there will be one laboratory period, one recitation and one illustrated lecture per week. In abbreviated form the same course (omitting the laboratory) will be given to the civil engineers during the first term. No change will be made in the required senior courses next year. The elective courses will be adapted to the needs of mechanical and electrical engineers who wish to carry their studies farther than the regular course permits. In addition to those already mentioned there will be illuminating engineering, applications of electrical machinery and current electrical topics.

Power Cost in a Turbo-Engine Railway Plant.

The following figures have recently come to hand in connection with the cost of producing electric power in a generating station devoted to interurban railway service, covering a period of one year. The plant is a turbo-engine alternating-current station equipped with two 650-hp and three 500-hp water-tube boilers, and three generating units. One unit is a 2000-kw, 13,200 volt, 25-cycle, three-phase, Curtis steam turbine set, and the other two are Rice & Sargent engines direct connected to General Electric alternators of 500-kw and 1000-kw rating. The plant is hand-fired, natural draft being used. The operating steam pressure is 150 lb. per square inch. The current generated at the station is delivered to transmission lines supplying rotary converter and step-down transformer substations, the cars being served with direct current at 600 volts. The road is about 30 miles long from end to end, most of the line being double tracked, with several single-track branches aggregating a total length of track in the property of 76.5 miles. The car mileage during the year was 1,820,985.

The total kw-hours generated during the year and delivered at the alternating-current busbars of the power plant were 10,050,616. Of this energy, 8,095,060 units were delivered at the direct-current busbars of the four substations, giving a transmission and reduction efficiency of about 80 per cent. The individual substations utilized from 1,500,000 to 3,000,000 kw-hours each, according to their locations and loading. The total expenses of station and substation operation were as follows:

	Station Operation.	All Substations
Coal	$58,295.52	.....
Wages	15,620.20	$1,840.59
Supplies	3,539.61	208.28
Repairs, steam	3,500.35	.....
Repairs, electrical	1,663.62	.....
Total	$82,619.30	$2,048.87

The cost of coal in this station for the year averaged $4.80 per ton. The plant is located about 22 miles from tide water, and the fuel had to be teamed to the storage yard before it could be wheeled into the boiler-room. The total operating force consisted of three engineers, four oilers, nine firemen, and four coal passers. The engines and turbine were operated condensing, with a cooling-tower installation having motor-driven fans and pumps to make up the water supply by repeated use of the condensation. Jet condensers were used on the engine sets, which were cross-compound units. The turbine outfit is not operated during the times when the station is running under light or average loads. The usual surface-condenser installation is provided for the turbine, with an extra large allowance of cooling surface on account of the high tem

	Cost per kw-hour, alternating at generating plant, cents.	Power station, cost per kw-hour, direct current at substations, cents.
Coal	0.581	0.720
Wages	0.155	0.216
Supplies	0.035	0.045
Repairs	0.051	0.064
Total	0.822	1.045

peratures sometimes reached by the water in the summer season. The total coal consumption of the plant during the year was 12,150 tons, New River being the kind of fuel used.

The unit cost of operation is given in the above table.

The Relation of Car Weights and Operating Costs.

An interesting technical analysis of the relation of car weights to operating costs was presented June 10 at the meeting of the Massachusetts Street Railway Association by Mr. Milan V. Ayres, electrical engineer of the Boston & Worcester Street Railway Company. Taking a 28-ton semi-convertible car equipped with four motors, Mr. Ayres found that on a run of 880 ft., with a maximum speed of 20 miles per hour, the energy consumed was 528 watt-hours, of which 345 watt-hours were consumed in acceleration, 70 watt-hours in rheostatic losses, 81 watt-hours in motor losses, 5 watt-hours in windage, and 27 watt-hours in track and bearing friction. Making the same run with a 16-ton car in the same time, the acceleration energy consumed was 173 watt-hours; rheostatic losses, 37 watt-hours; motor losses, 42 watt-hours; windage, 5 watt-hours; friction, 19 watt-hours; total, 276 watt-hours, or a reduction of 47.8 per cent. With power costing 1.5 cents per kw-hour at the car, and a daily run of 150 miles, the cost of operating the car represents a current expense of $100 per ton per year.

Among other figures submitted was a statement of the total cost of operating a car per year on the pound basis, including fixed charges and repairs. With a daily run of 150 miles, and power at 1 cent per kw-hour, the yearly power cost per pound is 3.42 cents; the fixed charges on the power plant (0.7 cent per kw-hour), 2.4 cents; and the repairs (0.0875 cent per ton-mile), 2.4 cents, making a total of 8.22 cents. This means, on an annuity basis, that a company can afford to pay 85.5 cents for every pound of weight in permanent parts that can be cut from its rolling stock. Through the use of steel and aluminum, with special efforts on the part of operating companies to have weights cut down, and the diminished use of wood, future progress in this direction will be attained.

New York Public Service Commissions' Accounting System.

A joint meeting of the accounting committees of the National Electric Light Association and the Empire State Gas and Electric Association was held at the office of Mr. H. M. Edwards, auditor, New York Edison Company, on June 10. The meeting was held for the purpose of considering questions regarding the system of accounts prescribed by the New York Public Service Commissions for electrical corporations. The questions had been submitted to the respective commissions and answered by their statisticians, Mr. A. F. Weber and Mr. W. J. Meyers, and referred, in turn, to the two committees. Twelve questions and answers transmitted from the commission of the First District were submitted and 67 from the commission of the Second District. The following, in addition to Mr. Edwards, attended the meeting: Messrs. F. L. Dame, Electrical Securities Corporation; E. J. Allegaert, Public Service Corporation of New Jersey; E. C. Scobel, Rochester Railway & Light Company, and Robert A. Carter, Westchester Lighting Company.

New York Public Service Commission News.

The Board of Estimate and Apportionment, of New York, has taken issue with the Public Service Commission over its refusal to sanction the charter of the South Shore Traction Company which asks the right to lay tracks through Queens Borough and across the new Blackwell's Island Bridge. This charter had been formerly granted by the Board of Estimate, but was turned down by the commission. The Board of Estimate claims that the commission exceeded its powers and usurped those of the board. A resolution has been passed condemning its action and calling on the corporation counsel to take all legal remedies to maintain the powers of the board. It is the plan to bring a suit that will throughly test section 53 of the public service commission law. The matter is considered important as establishing the status of the commission with regard to the franchises of surface lines.

In response to an application, the Public Service Commission has decided that the bondholders may operate the old Fulton Street Crosstown Car Line in New York. Before the Metropolitan Street Railway Company abandoned this line it was used by horse cars. The bondholders hope to make some arrangement by which the line can either be leased or operated electrically by some other company.

Mayor McClellan has signed the franchise of the Hudson & Manhattan Railroad for its tunnel under Sixth Avenue to Grand Central Station, and the work of getting the property consents has already begun. Mr. McAdoo, president of the road, says that all legal matters will be out of the way within six months.

The South Flatbush Railroad Company, recently organized, has made application to the Public Service Commission of the First District for permission to construct a line three miles long in South Brooklyn and also for permission to issue $30,000 of stock. The company does not contemplate the issue of bonds at this time.

Hearing by Massachusetts Commission on Consolidation of Lighting Properties.

The Massachusetts Gas and Electric Light Commission gave a hearing on June 8 at its offices in Boston on the petition of the Edison Electric Illuminating Company of Boston for permission to purchase the electrical properties of the Boston Consolidated Gas Company, the Newton & Watertown Gas Light Company, the Waltham Gas Light Company, and the Chelsea Gas Light Company. Counsel Everett W. Burdett for the Edison Company stated that the prices agreed upon are as follows: Boston Consolidated (Brookline), $1,300,000; Chelsea, $350,000; Waltham, $600,000; Newton, $500,000. The gas property of the Waltham company is to be purchased by the Newton company at a price of $500,000. Mr. Burdett said that the money will be borrowed on the Edison Company's credit and that later an issue of stock will be asked for, including several other prospective uses of capital.

Mr. Burdett then stated that the Edison Company feels that great advantages will accrue to all concerned in the line of economical operation, as a result of the consolidation. The above prices were reached after negotiations extending through many months. In all cases they are in excess of the property values totalized, since they are all going concerns. Good will is not included in any of the figures. The book values of the companies are: Boston, $963,000; Chelsea, $265,000; Waltham, $470,000; and Newton, $459,000. The total book values are $2,157,000, and the total purchase price for the properties, $593,000. The gross earnings of the companies are at present $569,000 per year.

The effect on the public, it was stated, will be lower prices and better service, without increase in the outstanding securities. If the approval of the board is given to the purchase, the Boston Edison rates will be placed in effect in all the communities affected on July 1, 1909. The arrangements now before the board are but the extensions of a policy of expansion which has long been successfully applied by the Edison Company, to the general improvement of economic conditions in the case of each property that has been taken over.

The estimated saving to the city and residents of Waltham per year by the consolidation will be from $14,000 to $17,000. The present 24-cp street lights, costing $20 per year, will be superseded by 40-cp lamps at $17; and the present $83.95 arc lamps per year will be supplanted by lamps of an improved type costing the city $65. No opposition has developed in Waltham to the proposed consolidation. In Chelsea there will be a saving of about $15,000 a year to the city and its residents. The city of Newton also favors the purchase. There the Boston Edison prices are already in effect, current having been supplied to the Newton & Watertown Gas Light Company for several years from the L Street station. Recently the rates in effect in Newton were greatly reduced by the application of the Boston prices. The estimated saving to the town and residents of Brookline is about $45,000 per year. All these estimated savings are figured on the basis of one-year contracts and are not contingent upon long-time contracts. If the latter can be arranged the economies will be still more advantageous to the municipalities.

Former Chairman Humphrey, of the Brookline Board of Selectmen, then spoke in favor of the purchase, and stated that there is no doubt that the Boston Edison Company can supply electricity to Brookline at a rate much lower than the Boston Consolidated Gas Company can afford to give in its electrical department. An appraisal was made, with a subsequent report, by Prof. D. C. Jackson, of Boston, advising the town to purchase electricity from the Boston Edison Company. This report has been abstracted in these columns, and the decision of the town to buy Edison energy was reached after about two years of investigation.

Mr. Burdett then stated that not a cent had been allowed in Brookline for good will, since the good will toward the Edison Company was already considerable, as compared with the feeling against the service rendered by the Boston Consolidated Gas Company in its electrical department. The latter organization is obviously handicapped by its inability to generate electricity on a large scale and to make a specialty of its distribution. Mr. Burdett stated that the purchase price cuts no figure in relation to the rates to be charged in the communities served by the Edison Company, since any securities issued later must be based on the property value rather than upon existing capitalization. There are also some presumptions in favor of the view that the price is not excessive, since it is for the interest of the Edison Company to buy at the lowest feasible terms. If a purchaser pays a gross price in excess of what is fair and later expects to capitalize it, he is only borrowing trouble. President James L. Richards, of the Boston Consolidated Gas Company, then took the floor and stated that the deal is for the best interests of all parties, including the public. He touched upon the economies incidental to the gas business in the way of consolidation, saying that he believed his company can serve the community better if the business is entirely divorced from the manufacture and sale of electricity. It is impossible for the gas people to serve the communities as low as can the Edison Company in electrical supply. In the book charges which Mr. Burdett cited there are no figures covering engineering and incidental costs during construction. The estimated saving in gas bills through the consolidation of gas properties directly or indirectly resulting from this deal is $36,000 per year.

President C. L. Edgar, of the Edison Electric Illuminating Company, Boston, was then called. He stated that the figures which are being paid are relatively no higher than the company has paid in the past in its absorption of local properties. The details of the Newton and Chelsea plants have already been laid before the board in connection with a previous petition. As for the prices to be paid for the Brookline and Waltham properties, Mr. Edgar stated that the company had asked Mr.

Herbert A. Wagner, a widely known central-station expert making a specialty of plant valuations, to inspect these properties and give his opinion of their worth. He estimated the Waltham plant to be worth $600,000, which is precisely the price that the Edison Company is paying for the Waltham electrical department; and the Brookline plant, Boston Consolidated Gas Company, to be worth between $1,400,000 and $1,500,000, whereas the price of the latter is $1,300,000. These concerns are all of the "going" variety, earning about $600,000 per year, and the price to be paid is therefore about 4.5 times the annual revenue, which is a moderate cost, since in many cases the revenue of public service properties is only one-seventh or one-eighth the purchase price. When the Legislature authorized the purchase of the Boston Electric Light Company by the Edison Company, the purchase price was in excess of the structural value, since the company was a going concern. The fact that the systems in Waltham and Brookline are of the same engineering type as that of the Edison Company makes it possible to coalesce them at less cost than as though the technical characteristics of the systems were different. Mr. Edgar said that it may easily occur that these properties may be worth substantially $3,000,000 to both parties, and yet be a bargain to both. The Boston Consolidated Gas Company cannot afford to do a picayune business; it must either drop its electrical service entirely or expand it, in order to approach economy. Hence the provision that the deal can be nullified if it does not go through in its entirety.

The British Patent Revocation Case.

In referring to the recent reversal, noted previously in these columns, of the decision of the British Comptroller-General revoking a patent to a foreigner on a flaming-arc lamp on the grounds that the invention covered was not manufactured to a sufficient extent in Great Britain, our London contemporary, the *Electrical Review,* says that the result of the appeal in this case will be received with general satisfaction. "Just what the law of 1907 was meant to do is the subject of more or less conflicting statements by rival claimants to the credit for its introduction and passing, but in Mr. Justice Parker's opinion it 'was never meant to penalize want of success when the patentee has done his best,' nor do we believe that it was intended to bestrew with rose leaves the path of the defendant to an infringement suit on imported apparatus, although it must be recognized that in certain cases an application for revocation may be very properly made by such a defendant.

"In time the drawbacks in the administration of the law may be removed. The new rules issued with commendable promptitude by the new Comptroller-General at the suggestion of Mr. Justice Parker, prevent the use of the law for merely 'fishing' purposes, and we do not doubt that, as further changes are shown to be necessary, they will be made, but no changes in the details of administration can alter the general character of the law, and its detrimental tendency. Lord Alverstone, the Lord Chief Justice of England, who, as Sir Richard Webster, was the leading patent counsel of his day, expressed his opinion of the law before the recent International Congress on Applied Chemistry.

"While presiding over the section for the discussion of law, political economy, and legislation affecting the chemical industry, he said that 'a real step backward had been made in the revoking clause of the new patent law. It would only result in people keeping their inventions secret and not taking out an English patent. The patent law should give protection to the inventor, and also secure the interests of the public. The inventor should have a fair and reasonable reward for his labors.' Lord Alverstone added that the new law had been made against his will and wish, and he thought that 'if it were changed to a more liberal standard, viz., the standard of a compulsory license, there would be no temptation to inventors to keep their invention secret.'

"It will probably need more hard cases than have yet arisen, and more definite evidence of detrimental operation than can yet have been possible, before any change will be effected in the law itself. We do not doubt that the expediency of such a change will in the course of time be sufficiently demonstrated, and in the meantime patentees must be content with a 'more liberal standard' in the methods of its administration, an example of which is to be found in Mr. Justice Parker's decision revoking the revocations."

CURRENT NEWS AND NOTES.

NON-MAGNETIC YACHT LAUNCHED.—The non-magnetic survey yacht, built for the Carnegie Institution, Washington, was launched at Brooklyn last week. The vessel will be used for ocean research in terrestrial magnetism, and contains no magnetic material in its structure. The vessel is 155 ft. long with 33 ft. beam and 12 ft. draft, and has a displacement of 568 tons.

TIME ENDORSEMENT ON TELEGRAMS.—Governor Draper, of Massachusetts, has approved a bill requiring that the time of sending and of receipt shall be endorsed on all telegraph messages transmitted within the boundaries of Massachusetts. The telegraph companies have announced that a charge will be made for the additional words and figures necessitated by this law.

NEW HAVEN RAILROAD ELECTRIC FREIGHT SERVICE.—Final action was taken this week by the board of directors of the New York, New Haven & Hartford Railroad on the extension of its electric service, whereby the Stamford-New Haven branch of the road will be electrically equipped for freight service initially, and later for passenger service. At present the New York-Stamford section is operated electrically only for passenger service.

WIRELESS TELEPHONY OVER 100 MILES.—In tests made at Toulon, France, June 8, of the Colin-Jeance system of wireless telegraphy between the cruiser *Condé* and the shore, conversation was maintained over a distance of 165 km (100 miles). It is stated that the tests established the fact that telephonic transmission without wires is hardly influenced by the electrical phenomena of the atmosphere, which hinder so seriously wireless telegraphy.

COMPULSORY MARINE WIRELESS.—Senator Frye, of Maine, chairman of the Committee on Commerce, introduced a bill in the Senate on June 9 providing that all ocean-going steamships carrying more than 50 passengers shall carry efficient wireless apparatus. Steamships which make trips of less than 200 miles from starting point to destination are exempted from the operation of the proposed bill. A fine of $2,000 is provided for all violations of the measure, which is to take effect one year after the date of its passage. The penalty clause of the bill contains this proviso: "That it shall constitute a good defence to a prosecution under this act for the defendant to show that the corporations supplying efficient apparatus for radio-communication have entered into a combination for the purpose of maintaining or enhancing the rental or price of such apparatus."

DAMAGES AWARDED TO THE INDIANAPOLIS LIGHT & HEAT COMPANY.—Judge Carter, of the Indiana Superior Court, has decided that the Board of Public Works had quasi-judicial powers, and rightfully awarded $25,000 damages to the Indianapolis Light & Heat Company, of Indianapolis, Ind., on account of the elevation of railroad tracks on Kentucky Avenue. This damage was divided in certain amounts against the city, the county, the street railway company, the Vandalia and the Big Four railroad companies. Judge Carter holds it the duty of the Board of Public Works to proceed to collect the several amounts and pay the same to the lighting company, but that the city alone cannot be held for the entire amount.

AMERICAN STREET RAILWAY CONVENTION.—The date of the Denver convention of the American Street and Interurban Railway Association and affiliated bodies has been changed from the week of Oct. 18 to the week of Oct. 4. One of the reasons for the change is that the earlier date will enable members to take advantage of low railroad excursion rates, and allow an opportunity to visit the Seattle Exposition.

NEW YORK STATE ELECTRICAL CONTRACTORS' ASSOCIATION.—The regular semi-annual meeting of the New York State Electrical Contractors' Association was held in Syracuse on June 15. Only routine business was transacted. After the business sessions the members were entertained at dinner by the entertainment committee of the Syracuse local branch of the association, of which Mr. James Hilton is chairman.

PUBLIC LIGHTING RESPONSIBILITY.—In a case brought before a court in Scotland, in which damages were asked for a death caused by an accident claimed to be due to darkness in a street in which the public gas lamps had not been promptly lighted, the judge ruled that the municipality was liable. "As soon as the sun ceases to give light," he said, "you must provide it; if you do not, you are responsible for the results."

ELECTRICAL MIND CURE.—A Pittsburgh paper reports that a young girl taken to an Eastern physician for electrical treatment pronounced herself greatly relieved after one experience, but the doctor's faith in his apparatus and his sense of humor were both challenged when he found that, through inadvertence, the electrical energy had not been utilized at all, and that such electrical effects as the patient experienced were simply those of imagination.

I. E. E. LIBRARY.—An English contemporary in referring to the library of the British Institution of Electrical Engineers said that the collection of electrotechnical books was so nearly perfect that the Institution took some pains to find out the exact distance from perfection, and the answer was that some 1600 works were wanting. Most of these have now been obtained, so that the I. E. E. library is now probably unsurpassed by that of any other technical society in the world.

NATIONAL ELECTRICAL TRADES ASSOCIATION.—The annual meeting of the National Electrical Trades Association will be held at the Exchange Club, Boston, June 21. This association has a total membership of 450 electrical manufacturers and jobbers in the principal sections of the country. Mr. Fred. P. Vose, of Chicago, is general secretary. Delegates will be present from the local associations in Philadelphia, Boston, Chicago, New York and San Francisco.

TELEPHONE SERVICE AT PANAMA.—Telephone communication has been established with the quarantine station on Culebra Island, Isthmus of Panama, by means of an old cable laid several years ago by the Central and South American Cable Company. This cable extended originally to Naos Island, but the shore end of the cable at that island was recently transferred to Culebra Island, and a few weeks ago telephone connections were made, and the line is now working satisfactorily.

CHICAGO ELECTRIC CLUB.—Mr. Francis T. Simmons, president of the Lincoln Park commissioners, of Chicago, addressed the noonday meeting of the Chicago Electric Club June 9 on "Lincoln Park, Its Ambitions, Its Progress and Its Effect Upon the City." Mr. Simmons showed some of the plans for the extension of Lincoln Park to the northward along the shore of Lake Michigan. He spoke incidentally of the recent contract which the Lincoln park commission made for drainage-canal power for the lighting of the park and boulevards. He also said that the commission had designs for ornamental concrete lamp-posts, which would probably be used for future work.

ELECTRIC TOWAGE FOR PANAMA CANAL.—In referring to the recent accident at the Canadian Soo Canal, in which the lock gates were badly damaged, one vessel sunk and two others injured, an official of the Panama Canal said that a similar disaster could not occur at a lock of the Isthmian canal, for there vessels will not make the passage with their own power, but will be towed through by electric power. The electric towing machines will run over a specially constructed track on the brink of the canal.

UNIVERSITY OF PITTSBURGH SCHOOL OF ENGINEERING.—With appropriate ceremonies the cornerstone of the School of Engineering of the University of Pittsburgh was laid on June 9. The exercises took place at commencement, and there was a number of engineering graduates, including three in electrical engineering. In an address at the cornerstone laying, Mayor Magee, of Pittsburgh, said that the event marked a forward step not only on behalf of rich men's sons, but also for the benefit of Pittsburgh's poor boys. Since the name of the institution has been changed to that of the University of Pittsburgh, it has come closer to the hearts of the people of the city, the Mayor added.

ILLINOIS TUNNEL COMPANY'S TELEPHONE FRANCHISE.—The Chicago City Council committee on gas, oil and electric light has extended until June 1, 1911, the time in which the Illinois Tunnel Company must have 20,000 telephones in operation under its franchise. The company is forbidden to sell out to any other interests than the Chicago Telephone Company before Dec. 1, 1910, and consideration of the proposed sale to the telephone company was set for June, 1910. Mr. H. D. Critchfield, representing the International Independent Telephone Association, told the committee that the interests he represented would not cease trying to obtain entrance to Chicago. He predicted a demonstration in favor of this grant of entry to the Independents that would make the council "sit up and take notice."

ELECTRICITY IN PORTO RICO.—A very interesting bulletin has just been issued by the Bureau of the Census on the electrical industries of Porto Rico, with statistical data to the end of 1907. The historical portion has been compiled by Mr. W. F. Willoughby, Secretary of the island. A considerable amount of information is given as to telegraphs and telephones, and as to electric lighting and electric railway development in the territory before and since American authority became controlling. The total cost of all electrical plants to 1907 is given as $2,373,258, with a total income of $663,031. Curiously the telephone investment was $255,041 and the electric lighting $146,795 only, while the street and electric railway cost was $1,971,512. The telegraphs and telephones are in the hands of the Porto Rico Bureau of Insular Telegraphs. No data are given as to isolated plants.

ELECTRIC LIGHTS AS MEMORIALS TO THE DEAD.—A church in New York has adopted a novel means to raise money to pay off a debt, which consists in the use of electric lights as memorials to the dead. A huge altar electrolier includes name-plates as part of its winding vine decoration, about each of which is a cluster of 10 incandescent lamps. Subscribers desiring the prayers of the congregation for their dead pay $1,000 for each light. The name of the deceased is then inscribed on the plate above the cluster of lights and one light is lit, to be kept burning at all services. The payment of each successive $1,000 means the lighting of another light, the maximum amount being $10,000 for each name. Eighteen of the name-plates have already been subscribed for and 30 lights purchased. The memorial is so constructed that it can be lengthened and enlarged almost endlessly, and the pastor of the church is reported to be looking forward to the day when it will reach the high vaulted ceiling and start twining its way along the sides of the chancel.

High-Tension Transmission System at Gaucin-Seville, Spain.

By FRANK KOESTER.

FOR utilizing the water of the river Guadiaro, a central station, "El Corchardo," has recently been built between the stations Gaucin and San Pablo of the Bobadilla-Algécircas Railway, in the province of Malaga, situated in the southern part of Spain. The minimum water available is 53 cu. ft. per second throughout the year, and 140 cu. ft. per second for eight months, the total head being 450 ft., while the net head is 421.5 ft. To harness the water, a dam 82 ft. long was built across the river. It is 12 ft. high, and 2.6 ft. thick at the top. The upstream side has a batter of 1 to 5, and the downstream side a batter of 2 to 5.

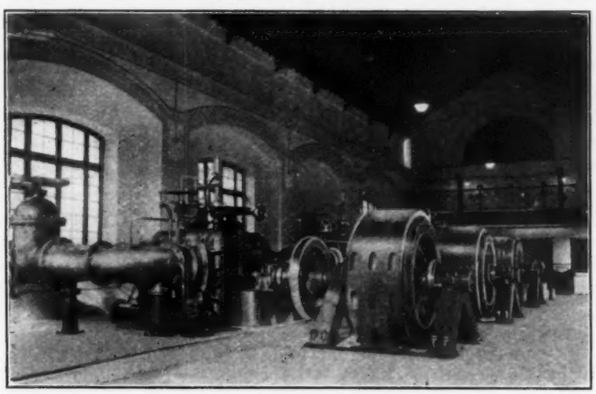


FIG. 1.—INTERIOR OF STATION.

The intake to the head-race is well provided with sluice gates and racks. The total length of the head-race is 18,695 ft., of which 3600 ft. runs through a tunnel. The remainder is built in an open trench form. It is 7.4 ft. wide and 4.7 ft. high, and has a pitch of 0.5 ft. in 1000; the tunnel has double the pitch.

The collecting basin is triangular in shape. The gate wall is 52.5 ft. wide, with provision for three penstocks, of which two are installed. It has a total storage capacity of 12,350 cu. ft. At the junction of the head-race is an overflow gate. Screens and gates are provided only for the two penstocks; the third is cut off by a temporary wall. The penstocks are 3.28 ft. in diameter. For a length of 650 ft. and up to a head of 160 ft. they are made of reinforced concrete; the remainder are made of Siemens-Martin steel, shipped in sections 19.7 ft. long. The sections are butt-jointed and riveted together.

FIG. 2.—COLLECTING BASIN.

The power house, shown in Fig. 1, is designed to accommodate four main turbines of which there are at present three installed. The turbines are of the impulse wheel type, and have a capacity of 1500 hp each, making 410 r.p.m. There are two 100-hp exciter turbines of the same type, connected to 65-kw, 110-volt generators making 1000 r.p.m. One exciter is sufficient for the four main units, while the other is kept in reserve, also for lighting the station. Each generator is rated at 1300 kva, 5000 volts, 40 cycles and 400 r.p.m. The machines are of the Oerlikon revolving-field, three-phase type, and are coupled to the horizontal turbine shaft by a flywheel coupling.

The switchboard and controlling gallery are located at the end of the generating room, in the switch house, from where the generating room is easily overlooked. It occupies practically the whole width of the generating room. In front of the switchboard are the generator columns, each bearing the instruments and levers for controlling a generator. There are installed seven single-phase, oil-insulated, water-cooled transformers arranged for two circuits in groups of three; the remaining transformer is kept in reserve, and in case of emergency can be thrown on either group. Each transformer has a rating of 600 kva. The primary is wound for 5000 volts and the secondary for 30,000 volts. By connecting the secondaries of the groups in star, 52,000 volts is obtained across each phase of the circuits. The busbar connections are such that each group can be thrown on either of the outgoing lines, or else both operated in parallel when necessary.

The total length of the transmission line is 75 miles. For a distance of 10.8 miles it runs through the province of Malaga, then 30 miles through the province of Cadax, and the last 34.2 miles run to the city of Seville. The highest point in the line is the crossing at Mt. Burrueco, 2525 ft. above sea level, while the lowest is in crossing the river Guadaira at Seville, where the elevation is 36 ft. above sea level.

All the transmission towers, of which there are 1550, are of structural steel; with few exceptions, they are made of two channels with transverse bracing. The average spacing of the towers is 260 ft.; however, the spans frequently exceed this, varying from 325 ft. to 400 ft., while there are other spans of 655 ft., 985 ft. and 1475 ft. The special steel towers are made of angle iron and are of the four-legged type, as shown in Figs. 4 and 5. The insulators are of the triple-petticoat type, and are carried on steel pins bolted to wooden arms clamped to the angle-iron guides of the towers. By

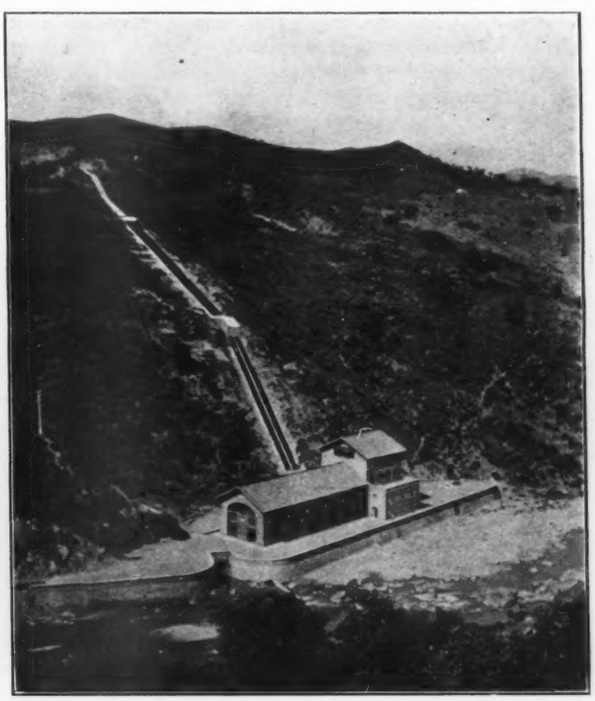
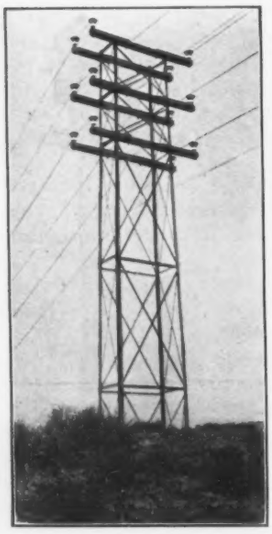


FIG. 3.—POWER HOUSE AND PENSTOCK RUN.

means of this arrangement, the spacing between phases does not depend on the tower design. If the voltage is raised at a future time, the length of the legs can be increased.

There are two three-phase circuits. For spans up to 300 ft. the conductors are 5.5 mm in diameter; up to 650 ft. they are 11 mm; above this copper cables are used. The phases are 3.28 ft. apart on the leg. Over its entire length the wires are transposed 35 times.



FIGS. 4 AND 5.—SPECIAL TRANSMISSION TOWERS.

Some 33 miles from the generating station, at Villamartin, is a switch and lightning-arrester house provided with horn-gap arresters and water rheostats. The circuit-breakers are of the Oerlikon remote-control type, placed in reinforced concrete cells. There are three substations: one at Utera, another at "Dos Hermanas" and the furthest one at Seville. The distances from the generating station are 56.5, 69 and 75 miles, respectively. In the substation at Utera are four single-phase transformers rated at 200 kva each; one being used as a reserve. The primary side is designed for 27,000 volts; the secondary for 3400 volts, 3500 volts and 3600 volts. As the incoming line has a tension of about 50,000 volts the transformers are connected similar to those in the main generating station—that is, the high-tension windings are connected in star. These transformers are of the oil-insulated, water-cooled type.

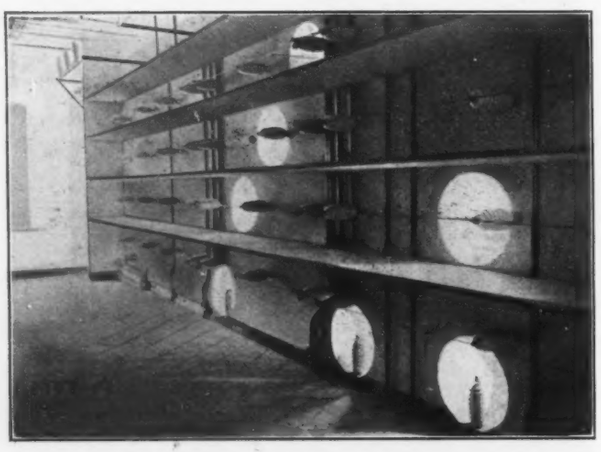


FIG. 6.—50,000-VOLT BUS-ROOM, SEVILLE SUBSTATION.

There are two low-tension buses to separate the lamp and motor load. The oil switches are of the remote-control type, and the low-tension switches are provided with overload and reverse-current relays. The 50,000-volt and the low-tension switches are mechanically operated. There are six high-tension horn-gap arresters provided with water resistance to ground.

At the substation "Dos Hermanas" is installed one three-phase, oil-insulated, water-cooled, 360-kva transformer, wound for 47,000 volts on the primary side, and on the secondary for 3400 volts, 3500 volts and 3600 volts. The switch gear is the same as that at the Utera station. The Seville substation contains seven single-phase transformers rated at 600 kva each. They are of the oil-cooled, water-circulated type. The primary side is wound for 27,000 volts and the secondary for 3500 volts. They are arranged in a continuous row (see Fig. 1) and are connected in two groups, similar to those in the power house; the odd transformer is kept as a reserve. The connections of the transformers, also of the switch gear and protecting devices are identical with those in the generating station. All high-tension switch gear is placed in concrete compartments. The operation of the high-tension switches is effected by pilot switches on the benchboard. The energy is distributed over the city of Seville and its vicinity through a 10-panel switchboard having the necessary indicating and recording instruments, switches, etc. The entire electrical equipment was furnished by the Ateliers de Construction Oerlikon, Switzerland.

Gas Producer Plants for Small Central Stations.

In a paper read at the recent meeting of the Southwestern Electrical and Gas Association at Dallas, Tex., Mr. W. B. Head pointed out some of the advantages of producer-gas plants to small central stations. He stated that 75 per cent of the small steam plants in Texas are operating under conditions which require from 10 lb. to 15 lb. of coal per brake hp-hour. The producer plant operating on Texas lignite will show an enormous saving over such plants. Several builders of producer plants are guaranteeing a fuel consumption of 2 lb. to 3 lb. of lignite per brake hp-hour, on a 50 per cent load factor. As Texas lignite can be had at a cost of about one-half that of Oklahoma coals the great saving is apparent.

The most important question, the question uppermost in the minds of all prospective purchasers, is, he said, the reliability of the outfit. It matters not how economical the outfit may be, if it cannot be depended on to meet the exacting requirements of the central station it has no place as a generator of electric current. Every central-station manager knows that nothing ruins the business so quickly as frequent interruptions in the service. After a year's experience with a 100-hp unit, Mr. Head felt safe in saying that a first-class producer plant is as reliable in every respect as a steam plant. A somewhat better class of labor is needed to operate a producer plant than a steam plant. Skill on the part of the engineer is not so necessary as carefulness; this especially applies to the engine. Any piece of heavy machinery, of many parts, operating at high speed, requires the best of attention. The cost of lubrication is about one-third more than that of a steam engine.

The question of the durability of the producer plant is one that pertains almost entirely to the engine, as there is almost nothing about the rest of the plant to depreciate. While the author had no accurate information on the up-keep of a gas engine, he thinks, compared with a steam engine, that it is considerably more. The cost of installation is about 40 per cent more than that of a steam plant.

Care should be exercised in locating the producer room. The floor should be high enough to give the water from the tar extractor considerable fall in order that it may get out of the building easily. In cold weather the tar becomes thick and is hard to pass through a sewer without considerable fall. Some sort of skimming device should be provided to separate the tar from the water, in order that the tar may be saved. Producer plants of 100 hp and larger should always have included with the installation a coal elevator for charging the producer.

In conclusion the author said that the successful use of lignite in the producer plant means much for Texas from an industrial standpoint.

The Efficiency of Asynchronous Machines Tested by the Loading-Back Method.

BY STANLEY P. SMITH.

IN this article a description will be given of a new and important application of the no-load and zero-speed circle diagram whereby the efficiency of induction machines, when tested by a modified Hopkinson method, may be accurately determined for both the motor and the generator. A method for calculating these results is then deduced and checked by means of the diagram.

Several problems arising in connection with induction motors can be solved or partially solved by means of the circle diagram. For instance, by aid of this diagram it is possible to find the amount of resistance which must be inserted in the secondary circuit in order to obtain a given torque at starting and to examine the behavior of the motor during acceleration. An interesting case is when the induction machine acts as a generator—that is, when the watt component becomes negative by reason of being driven above synchronism.

An actual example of this occurs when two asynchronous machines are tested by the modified Hopkinson method, where one machine is made to pump back energy to the other. Since there is generally a great deal of uncertainty about the results when calculated from such tests, owing to the unsatisfactory nature of the assumptions which have to be made, it may be well worth while to show how simply accurate results can be obtained from the diagram, and also to see if the latter cannot be of assistance in deducing some method of calculation which will give results in harmony with facts.

APPLICATION OF CIRCLE DIAGRAM TO THE LOADING-BACK METHOD OF TESTING ASYNCHRONOUS MACHINES.

For this purpose use can be made of the results obtained from certain 300-hp motors which were tested in this way. The connections for the test are shown in Fig. 2, while the circle diagram is shown in Fig. 1.

Referring to Fig. 2, the motor M drives the generator G at a certain speed above synchronism. The load on the machines is adjusted by means of resistances inserted in the secondary circuit of the generator. Measurements are made of the loss absorbed in these resistances P_r, the motor input W_{mi} and the total losses of the system P.

The machines, built at Messrs. Siemens Brothers Dynamo Works, Stafford, were designed as motors for 2750 volts, three-phase, with a frequency of 40 cycles per second. The number of poles was 10, thus giving a synchronous speed of 480 r.p.m.

The data from which the diagram for these motors, shown in Fig. 1, was drawn was deduced from the test results indicated below, which are the mean of those given by the two motors.

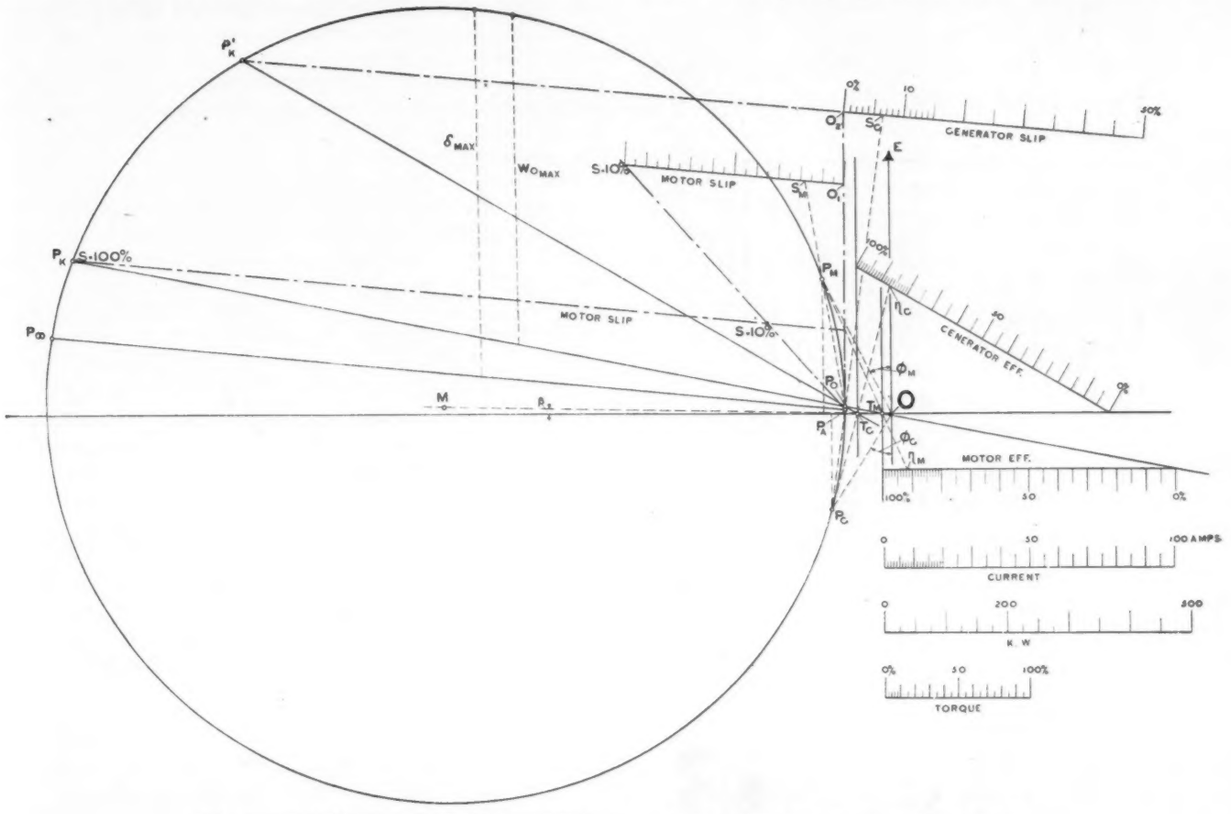


FIG. 1.—NO-LOAD AND ZERO-SPEED DIAGRAM OF 300-HP, THREE-PHASE INDUCTION MOTOR.

(I.) *No-Load Measurements,* that is, machine running light.

No-load loss $= 11.7$ kw.

No-load current $I_0 = 16.0$ amp.

$$\text{Then } \cos \Theta_0 = \frac{11.7 \times 1000}{16.0 \times 2750 \times \sqrt{3}} = 0.15$$

No-load watt component:

$$I_{ow} = I_0 \cos \Theta_0 = 16.0 \times 0.15 = 2.4 \text{ amp.}$$

$$\text{or} = \frac{11.7 \times 1000}{\sqrt{3} \times 2750} = 2.4 \text{ amp.}$$

No-load wattless component:

$$I_{owl} = I_0 \sin (\cos^{-1} 0.15) = 16.0 \times \sin 81^\circ$$
$$= 16.0 \times 0.99 = 15.8 \text{ amp.}$$

(II.) *Magnetization Measurements:*

Iron loss $= 6.4$ kw.

Hence, watt component of magnetizing current:

$$I_{aw} = \frac{6.4 \times 1000}{\sqrt{3} \times 2750} = 1.4 \text{ amp.}$$

*The points P_1, P_0 and P_k are the magnetizing, no-load and zero-speed points respectively of the normal motor. The point P'_k is the zero-speed point for the special case of the machine working as a generator with a definite resistance inserted in the secondary circuit.

Wattless component $I_{awl} = I_{owl} = 15.8$ amp approx.

(III.) *Measurements at Zero Speed.*

Measured: Current, 95 amp.
E.m.f., 920 volts
Loss, 28.5 kw.

Then, power factor at zero speed

$$\text{Cos } \theta_k = \frac{28.5 \times 1000}{\sqrt{3} \times 95 \times 920} = 0.19$$

Zero-speed current:

$$I_k = \frac{2750}{920} \times 95 = 284 \text{ amp.}$$

Watt component of zero-speed current:

$$I_{kw} = I_k \cos \theta_k = 284 \times 0.19 = 54 \text{ amp.}$$

Wattless component of zero-speed current:

$$I_{kwl} = \sqrt{I^2_k - I^2_{kw}} = \sqrt{(284+54) \cdot (284-54)} = 279 \text{ amp.}$$

The points P_o, P_a and P_k were then set off to scale in Fig. 1.

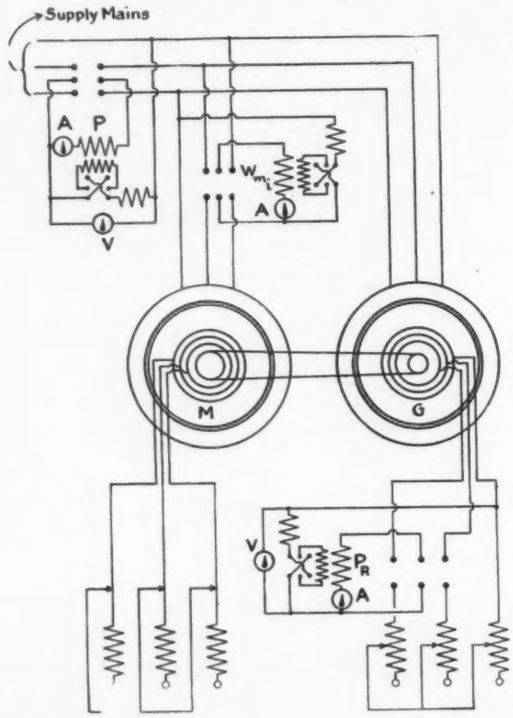


FIG. 2.—CONNECTIONS FOR TESTING INDUCTION MOTORS.

To find the line on which the center M of the circle lies,

$$\tan \beta = \frac{I_{ow} \sin \theta_k + I_{owl} \cos \theta_k}{I_k + I_{owl} \sin \theta_k - I_{ow} \cos \theta_k}$$

$$= \frac{2.4 \times 0.98 + 15.8 \times 0.19}{284 + 15.8 \times 0.98 - 2.4 \times 0.19}$$

$$= \frac{2.35 + 3.0}{284 + 15.5 - 0.45} = \frac{5.35}{299.05} = 0.0179$$

whence $\beta = 1°$.

Then draw $O\,M$ to make an angle of 1 deg. with the abscissa axis and determine the position of M by bisecting the line $P_k P_o$. The circle can now be drawn and the characteristic curves of the motor determined in the usual way.

Motor input				Total loss in	Generator output,	Loss in inserted resistance in generator secondary.	
Volts.	Amps.	Kw_{mi}.	Cos θ_m.	Kw $= P_r$.	$W_{go} = W_{mi} - P_r$.	Volts $= E_2$.	Kw $= P_r$.
2,760	50.6	218	0.9	60.5	157.5	33	11.5

Consider now the above set of readings taken from a Hopkinson test of these machines. The power factor for the motor, cos θ_m, at the input W_{mi} is obtained directly from the readings, but to what load do these readings refer? This, of course, involves the question of efficiency, which is always difficult to calculate from such test results owing to the uncertainty of the belt losses, etc.; use can now be made of the diagram. In passing, it may be noted that, if there is any inaccuracy in the method about to be employed, it is entirely negligible compared with that which has already gone before, namely, the experimental error in taking the readings or when compared with any of the generally used methods of computing the efficiency from these results. Indeed, it may safely be said that not only the efficiency but also the slip and power factor can be found more readily from the diagram, provided only that the above power readings can be relied on.

Now the motor efficiency is obtained at once from the diagram by setting off the point P_m, as shown in Fig. 1, the ordinate representing the motor input $W_{mi} = 218$ kw and $O\,P_m$ the current = 50.6 amp. As is seen, the power factor cos $\theta_m = 0.9$; the slip $s_m = 1.7$ per cent; while the efficiency $\eta_m = 91.6$ per cent, and therefore the output $W_{mo} = \eta_m W_{mi} = 200$ kw. Thus the output to which the above efficiency, power factor and slip of the motor correspond is accurately determined from the diagram and equals 200 kw = 268 hp.

It is equally simple to determine the efficiency of the machine as a generator also, but in doing so it must not be forgotten that the generator secondary resistance is greater than the normal owing to the inserted resistance r_i, which will make the efficiency η_g much less than if the machine were working normally. This fact, however, introduces no difficulty provided the new zero-speed point P'_k corresponding to this case is located. It is necessary merely to ascertain the inserted resistance per phase from the above set of readings:

$$r_i = \frac{3 E^2_2}{1000 P_r} = \frac{3 \times 33^2}{11{,}500} = 0.284 \text{ ohm.}$$

Reducing this value to primary terms.

$$r'_i = 0.284 \times 3.62^2 = 3.73 \text{ ohm.}$$

where turns on primary/turns on secondary = 3.62. Hence the total resistance per secondary phase reduced to primary:

$$= r'_2 + r'_i = 0.47 + 3.73 = 4.2 \text{ ohm.}$$

Before finding the current, however, one must also know the reactance. Now from the readings for the zero-speed constant P_k the impedance per phase at zero speed is found to be

$$Z_k = \frac{E}{\sqrt{3} I_k} = \frac{2750}{\sqrt{3} \times 284} = 5.6 \text{ ohm.}$$

whence reactance per phase

$$X_k = \sqrt{Z^2_k - r^2_k} = \sqrt{5.6^2 - 0.94^2} = 5.5 \text{ ohm.}$$

where

$$r_k = r_1 + r'_2 = 0.47 + 0.47 = 0.94 \text{ ohm.}$$

Hence with the resistance r_i' inserted in the secondary circuit, the impedance per phase will be:

$$Z'_k = \sqrt{\{r_1 + (r'_2 + r'_i)\}^2 + X^2_k}$$

$$= \sqrt{(0.47 + 4.2)^2 + 5.5^2}$$

$$= 7.2 \text{ ohm.}$$

From this value the zero-speed current at P'_k is found to be:

$$I'_k = \frac{E}{\sqrt{3} Z'_k} = \frac{2750}{\sqrt{3} \times 7.2} = 220 \text{ amp.}$$

Now, provided the motor is not working in the neighborhood of synchronism, the magnetizing current will not introduce any appreciable error, and P'_k can be set off directly on the circle.

The point P'_k, representing I'_k, is thus shown in Fig. 1, while P_g, the point corresponding to the generator output, is drawn on the lower half of the circle. To obtain the power factor, efficiency and slip for this condition it is necessary merely to find the corresponding lines just as in the case of a motor. In this case, of course, the abscissa axis represents the line of zero output, while the line $\overline{P'_k P_o}$ represents zero input, the conditions being just the reverse to those of a motor. The efficiency line is then drawn parallel to the line $\overline{P'_k P_o}$

where the mechanical input is zero, and is bounded by the abscissa axis representing zero efficiency and the no-loss line passing through T_g representing 100 per cent efficiency. As seen from the diagram, the efficiency of $\eta_g = 86.7$ per cent and the power factor cos $\Theta_g = 0.85$. For the slip—which is negative—a line parallel to $\overline{P_a P_\infty}$ is drawn to pass through P'_k. This line $\overline{P'_k O_2}$ (Fig. 1) is produced backward beyond the tangent at P_a, and a length $= \frac{1}{2}\overline{P'_k O_2}$ is divided into 50 parts in a similar way to the slip line for the normal motor. The the slip s_g is thus = 6.4 per cent.

It is thus seen that the diagram affords a complete insight into the behavior of the machines during the above test, and at once gives the efficiencies, etc., without requiring any correction whatsoever for belt slipping and similar difficulties encountered in calculations. It must be remembered, of course, that η_g represents the efficiency of the generator at an output of 157.5 kw with respect to the zero-speed point P'_k, that is, the efficiency of the generator as on test, and not under normal conditions. Had the inserted resistance been zero, then, of course, the machine would have been working normally with P_k as its zero-speed point. With a given ratio of pulleys, however, this desideratum is not always easy to be obtained.

CALCULATION OF EFFICIENCY FROM MODIFIED HOPKINSON TEST OF INDUCTION MOTORS.

As seen from the foregoing, it is quite easy to measure the motor input and the generator output; the difficulty is to determine the loads to which these correspond. Now, although the above graphical method gives in a simple manner results the reliability of which only depends on the accuracy of the readings, yet it may not always be desirable or possible to construct such a diagram for obtaining these results. Since, however, there is at hand a useful check on any analytical method that may be deduced, it is well to find some such means whereby the efficiency can be properly calculated. To do this, proceed as follows:

After adjusting the pulleys, etc., until the induction motor is able to drive the induction generator under the required conditions—the losses and wattless current being supplied from an independent electric source—let resistance be inserted in the rotor circuit of the generator until the input to the motor is as much above the load at which the machines are to be tested as the output of the generator is below this load. Since then the efficiency curve of an induction machine is practically a straight line over the working range, it is obvious that the efficiency of both the generator and the motor with respect to this mean load would be about the same if both machines were working under normal conditions.

Then measure:*

I. Total losses = power taken from supply mains = P.
II. Motor input = Wm_i.
III. Losses in resistance inserted in the generator secondary circuit = P_r.
IV. Speeds of the motor and the generator and the frequency of the supply current.

Starting then from the definition that the combined efficiency of the two machines is:

$$\eta_{mg} = \frac{\Sigma \text{ outputs}}{\Sigma \text{ inputs}} = \frac{\Sigma \text{ outputs}}{\text{motor input}}$$

Then

$$\eta_{mg} = \frac{Wg_o + Pb_o + Pb_1 + Pr}{Wm_i}$$

Where Wg_o = generator output = $Wm_i - P$.
Pb_o = belt loss at no-load.
Pb_1 = additional belt loss under load.
Pr = loss in resistance inserted in the generator secdary circuit.

*In addition to these measurements, it is also well to measure the generator output Wg_o, if instruments are available. In certain cases it may be better to measure Wg_o than P; in the present test the generator output Wg_o was obtained by deducting the total loss P from the motor input Wm_i.

It is necessary now to ascertain how these several quantities can be determined.

To find the *no-load belt loss Pb_o, measure:*

(a) the loss P when the motor is driving the generator and secondary circuit of the latter is open, but its primary is connected to the mains. Denote this loss by P'. Any small iron loss in the generator rotor will be usually quite negligible.

(b) The loss P when the belts (or ropes) are thrown off and both machines are running light. Denote this loss by P''.

The no-load belt loss is

$$Pb_o = P' - P''.$$

To find the *additional belt loss under load Pb_1:*

For the additional belt loss which occurs under load due to the increased belt-slip, proceed as follows: Let d_m and d_g equal the effective diameters of the motor and generator pulleys respectively, after the thickness of the belt has been taken into account. Now if there were no belt slip under load,

$$\frac{\text{speed of generator}}{\text{speed of motor}} = \frac{d_m}{d_g}$$

Actually, however,

$$\frac{\text{speed of generator}}{\text{speed of motor}} = \frac{d_m}{d_g} \cdot \frac{1-c}{1}$$

where c is a constant representing the slip of the belt and is < 1.

Further, let s_g and s_m denote, respectively, slips from synchronism as measured on the generator and the motor under test.

Then

$$\frac{\text{speed of generator}}{\text{speed of motor}} = \frac{1+s_g}{1-s_m}$$

By substituting these two expressions for the ratio of the speeds the value of c is found.
Thus

$$\frac{d_m}{d_g}\frac{1-c}{1} = \frac{1+s_g}{1-s_m}$$

that is,

$$1 - c = \frac{d_g}{d_m}\frac{1+s_g}{1-s_m}$$

or

$$c = 1 - \frac{d_g}{d_m}\frac{1+s_g}{1-s_m}$$

In the present case, which was a rope drive—there being eight 1¼-in. ropes to transmit the power—the effective diameter of the motor pulley was 45 in. and that of the generator 40 in., whence

$$c = 1 - \frac{d_g}{d_m}\frac{1+s_g}{1-s_m} = 1 - 0.89\,\frac{1+s_g}{1-s_m}$$

Now c represents the amount by which the generator speed is reduced owing to the belt slip, and since this is practically zero at no-load it may be taken as the correction for the reduced speed of the generator caused by the slipping or creeping of the belt under load. Since then only the $(1-c)$th part of the motor output is conveyed to the generator, it is obvious that a cth part of the motor output must be consumed in producing heat at the pulleys. Hence for the additional belt loss under load:

$$Pb_1 = cWm_o = cWm_i\,\eta_m$$

The efficiency of the motor can be estimated quite accurately enough for the purpose of finding Pb_1, since c is always very small when the belts are properly tightened.

In this way the combined efficiency η_{mg} can be found, and it now remains to split up η_{mg} into the separate efficiencies η_m and η_g. Before doing this, however, the combined efficiency η_{mg} for these machines will be calculated from the test results in the above table.

For the slips use will be made of the values as given by the diagram, though these can equally well be measured.

Then, motor slip $s_m = 1.7$ per cent and generator slip $s_g = 6.4$ per cent,

whence, const. $c = 1 - 0.89 \frac{1 + s_g^*}{1 - s_m} = 1 - 0.89 \frac{1.064}{0.983} = 0.04$

Motor Input:

Pressure = 2760 volts. Current = 50.6 amp. Input Wm_i = 218 kw

whence $\cos \Theta_m = \frac{218 \times 1000}{\sqrt{3} \times 2760 \times 50.6} = 0.9$

Total losses supplied to system

$$P = 60.5 \text{ kw.}$$

Hence, output of generator is

$$Wg_o = Wm_i - P = 218 - 60.5 = 157.5 \text{ kw.}$$

Measured loss in resistance inserted in the generator secondary circuit:

$$Pr = 11.5 \text{ kw.}$$

No-load belt loss

$$Pb_o = 10 \text{ kw.}$$

Additional belt loss

$$Pb_1 = c.\ Wm_i\ \eta_m = 0.04 \times 218 \times 0.9 = 7.5 \text{ kw.}$$

Hence,

$$\Sigma \text{ outputs} = Wg_o + Pb_o + Pb_1 + Pr$$
$$= 157.5 + 10 + 7.5 + 11.5 = 186.5 \text{ kw.}$$

Then, combined efficiency

$$\eta_{mg} = \frac{\Sigma \text{ outputs}}{Wm_i} = \frac{186.5}{218} = 0.85.$$

It is necessary now to analyze this combined efficiency.

To do this, consider the *losses in the two machines*—these are: $Wm_i - \Sigma$ outputs $= 218 - 186.5 = 31.5$ kw. Now, if one-half of these losses occur in the motor and the other half in the generator, it is clear that the motor efficiency will be higher than that of the generator. But it is not known how these losses are distributed between the two machines and the simplest procedure is not to trouble about the *actual* loads, but to take the load corresponding to which the generator efficiency equals the motor efficiency, so that $\eta_m = \eta_g = \sqrt{\eta_{mg}}$. Now if there were no external losses (outputs) in the belts, etc., the *corresponding mean load would be* $\frac{1}{2}(Wm_o + Wg_o)$, but under actual conditions it will be better to find this load from the machine working under normal conditions, namely, the motor, by deducting from the output of the latter half the losses in the two machines. This procedure, though not strictly accurate, is quite good enough for all practical purposes. Taking then the corresponding mean load $\eta_m Wm_i - \frac{1}{2}(Wm_i - \Sigma$ outputs) we have with respect to this load:

$$\eta_m = \eta_g = \sqrt{\eta_{mg}} = \sqrt{0.85} = 92.2 \text{ per cent}$$

where η_m and η_g both refer to the machine working normally with an output of $\eta_m Wm_i - \frac{1}{2}(Wm_i - \Sigma$ outputs$) = 0.922 \times 218 - \frac{1}{2}(218 - 186.5) = 201 - 15.75 = 185$ kw or $= 247$ hp.

From the diagram Fig. 1, the efficiency at this load is $\eta_m =$ 91.5 per cent, consequently the agreement between calculation and the diagram is within 1 per cent.

It is seen, therefore, that the above method of calculating the efficiency gives results which are in good agreement with those yielded by the diagram, and may, therefore, together with the latter method, be regarded as a satisfactory way of determining the efficiency of induction motors when tested by the modified Hopkinson method.

It may be useful to summarize briefly the above method for calculating the efficiency:

(1) Measure, in the way above described, the motor input Wm_i, the generator output Wg_o, the no-load belt loss Pb_o, the additional belt loss Pb_1, the loss in resistance inserted in the generator secondary Pr.

(2) Determine combined efficiency:

$$\eta_{mg} = \frac{\Sigma \text{ outputs}}{\Sigma \text{ inputs}} = \frac{Wg_o + Pb_o + Pb_1 + Pr}{Wm_i}$$

(3) Then the separate efficiencies η_m and η_g of the two machines is $\sqrt{\eta_{mg}}$ with respect to the corresponding mean load $Wm_o - \frac{1}{2}$ losses in machines $= \eta_m Wm_i - \frac{1}{2}(Wm_i - \Sigma$ outputs) as output.

*It must be borne in mind the s_g is negative.

Recent Improvements in Underground Conduit Construction.

By S. B. Way.

THE city of St. Louis has, during the past two or three years, witnessed some radical departures from accepted methods of conduit construction. During the year 1906 the electric light and power interests of that city found it desirable to install considerable conduit incidental to an extension of the system of distributing electricity for general use and for extending high-tension feeders to reach distant street-railway substations. A fairly large stock of multiple-duct tile conduit was on hand, but not in sufficient quantity for the requirements of the work contemplated. An investigation of the conduit market developed a condition not at all encouraging to those responsible for the completion of the work in hand within the required time, in that all of the conduit manufacturers were then already sold out of the kind of duct desired. This state of affairs made it necessary for the engineers in charge of the work to choose between completing the work with such conduit as could be purchased and delivered within the time limit or to devise some means of building a conduit without the usual tile or other pipe. The engineers chose to make an attempt to get along without the pipe, and incidentally save money in the cost of construction. This resulted in building a conduit entirely of concrete.

Upward of 170,000 duct-ft. of all-concrete or monolithic conduit has been laid in St. Louis within the last three years; fulfilling every requirement for all uses, from single-duct runs with frequent junction or service boxes, to replace Edison tube, to heavy isolated runs for high-tension cable.

The ideal conduit, or housing, for underground conductors must have smooth, clear, jointless, fireproof duct openings, free from pockets or depressions in which water may lodge; should be laid to true grade to drain to manholes; must be constructed of a material of high electrical resistance, and which will be homogeneous and not deteriorate with age; must be strong and able to sustain itself and a considerable load over fairly long spans, and it must be cheap.

The almost universally accepted practice in this country of constructing conduits of single or multiple clay tile, fiber wood, cement or iron pipe, with a jacket or supporting armor of concrete, obviously falls far short of the ideal construction. Any of these methods of constructing ducts depend on the concrete armor for strength and ability to withstand the usual cuts, excavation and city improvements continually met with in the streets of large cities; and if the concrete armor is weakened or carelessly applied, the pipes of various kinds resemble beads strung upon a wire and serve no useful purpose except to provide a hole or duct of uncertain size, smoothness and continuity between manholes.

In constructing a conduit with clay or other pipe as a means of obtaining the duct openings, a bottom layer of concrete is thrown into the trench and leveled off, after which the pipe structure is built up on the concrete, necessitating the presence of workmen in the trench and the handling of a large amount of heavy material, which, even with the most careful methods, causes quantities of earth to be carried into the trench and deposited onto the concrete, seriously interfering with the bond between the bottom layer of concrete and the sides and top of the concrete armor or envelope, materially weakening the structure. In laying the pipes it is difficult to obtain perfect alignment and sealing. Each new section of pipe must be fitted to the preceding one, which jars or moves the pipe already laid to a greater or less extent, depending upon the skill of the workman and the quantity of the material he is using. After the pipes are laid there is no absolute inspection

of the ducts possible, and the only information the owner can obtain relating to the presence of foreign matter, alignment and sealing is derived from the passage of a short mandrel through the various ducts. Drawing a mandrel through a duct can do no more than demonstrate that there exists a hole sufficiently large and straight to permit the mandrel to pass through it. It is desirable in any conduit that the ducts be completely isolated from each other and that the ducts be free from water-pockets or depressions and present a large and smooth surface as a bed for the cable, in order that ground currents may be

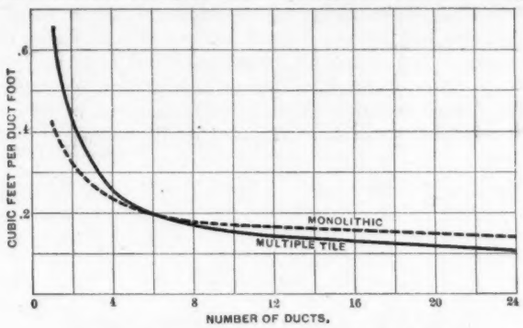


FIG. 1.—CURVE OF CONCRETE PER DUCT-FOOT.

equally distributed over the greatest possible area of the cable sheath, so that local electrolytic action may be minimized. Conduits built up of single-duct tile or pipe offer greater isolation of individual ducts, but are more expensive to construct than conduits built up of multiple-duct tile. Multiple-duct tiles afford communication between all of the ducts in the tile at

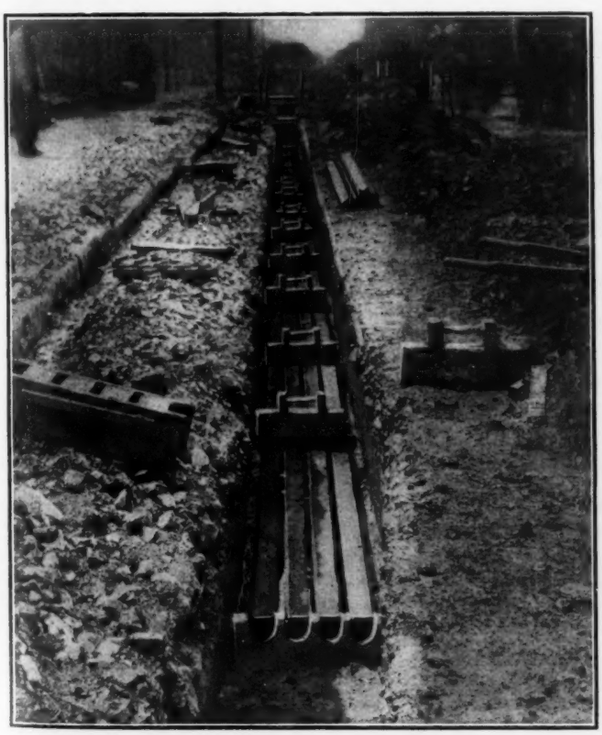


FIG. 2.—TRENCHES WITH FORMS READY FOR CONCRETE.

every joint, or at points 3 ft. apart, and such construction permits a burning cable to throw fire and hot metal through the joints to the other ducts in the tile, even though the tile partitions between the ducts are not melted or evaporated by he arc, which is the usual result following a cable burn-out in tile construction.

It has been found that all-concrete or monolithic conduit possesses many advantages over a conduit built up of pipes of whatever nature, in that with such construction the structure becomes homogeneous; occupies less space for a given number of ducts of equal size; permits perfect inspection of each duct from end to end incidental to the laying of each tier; pro-

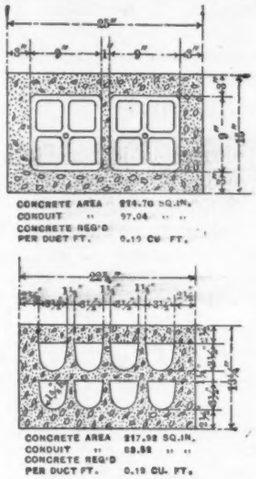


FIG. 3.—COMPARATIVE DIMENSIONS OF STANDARD TILE AND MONOLITHIC CONDUIT.

vides smooth, straight, clear, jointless and fireproof duct openings from manhole to manhole; eliminates handling, fitting, breakage and cost of pipe; requires no factory, and but few and simple special tools; and for average duct sections uses no more material (concrete) than is required for the armor or envelope of pipe construction. The amount of concrete per

FIG. 4.—OPEN-TOP DUCTS WITH CONCRETE COVERS.

duct-foot required for various duct sections for multiple-duct tile and for monolithic conduit and the cost per duct-foot of completed work, exclusive of trenching, refilling and repaving, are shown by curves in Fig. 1. These curves were plotted from results obtained in actually laying a considerable quantity of each type of conduit under the same supervision and by the same men. The multiple-duct tile was laid with a 3-in. armor of concrete and with the interstices between the tiles filled with fine concrete, while the monolithic conduit was provided with

2½ in. of concrete between the ducts and the bottom and sides of the trench, with a cover or top 3 in. thick. The items of trenching, refilling and repaving are nearly constant for each type of conduit, except a small differential of about ½ cent per duct-foot in favor of monolithic conduit due to the smaller trench and consequent reduced excavation and hauling of displaced earth required by the monolithic construction. Typical cross-sections of multiple-duct tile and monolithic conduit are shown in Fig. 3.

The construction of monolithic conduit involves only the comparatively simple methods of good concrete work. After a trench of suitable width and depth has been excavated, duct-form supports are set to grade and perfect alignment on 16-ft. centers in the bottom of the trench. These duct-form supports serve to hold the forms or molds for producing the duct openings rigidly in place and in true alignment while the concrete is worked into place in the bottom of the trench. The duct forms or molds consist of 16-ft. sections of clear, straight-grained lumber previously dressed to the shape of a "U," and are held down in the duct-form supports against the buoyancy of the plastic concrete by suitable cast-iron, or other, weights. When the duct forms are set, concrete of the proper mixture for good concrete work is dumped into the trench and suitably rammed and puddled around the forms and finally struck off level with the tops of the molds. The concrete is then allowed to take its initial set, which in favorable weather requires about three hours, when the duct forms may be removed by simply

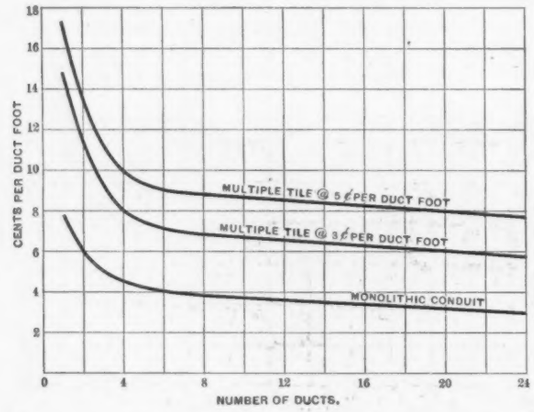


FIG. 5.—DUCT CONNECTION COSTS.

lifting them upward and out of the concrete, leaving smooth, straight, continuous U-shaped grooves in the bed of concrete just laid, which, when covered, constitute the duct openings. Fig. 2 shows the trench with forms set ready for the concrete to be dumped in.

After the duct forms are removed from the concrete, the smooth, continuous grooves molded in the concrete by the forms are open to the daylight for the full length of the construction and every possible facility is afforded for perfect and rapid inspection. Any faults in the work may be instantly detected, and this in itself is a potent factor in securing first-class work.

The open top ducts are closed in by laying across the top of the structure thin, smooth plates, or slabs, of concrete molded on the site of the work. These slabs, or plates, of concrete are made of just sufficient width to lap over each outside duct a short distance, and are laid as illustrated in Fig. 4, with a small quantity of mortar to seal the joints. The thin concrete slabs, or plates, serve the double purpose of closing in the top of the newly formed ducts and as a foundation or support for the next layer of concrete in which an additional tier of ducts may be formed in the same manner as the preceding tier, this operation being repeated as often as necessary to produce the required number of duct openings. The top of the conduit is closed in in the same manner, with the exception that the top layer of concrete contains no duct forms and acts simply as an armor or envelope to protect the conduit construction from future excavators.

In addition to its lower first cost and other important advantages, monolithic conduit is especially well adapted to be used as a conduit for local distribution. "Blind" handholes, or service boxes, are readily molded in the concrete structure intercepting any desired number of ducts. In molding these handholes or service boxes, the duct forms are allowed to pass through and the concrete flowing around the duct forms is stopped off by suitable forms arranged to fit closely around the duct molds. Such handholes or service boxes can be installed at as frequent intervals as desired without increasing the cost of the construction, inasmuch as no additional material is required. The top of the handhole or service box is closed in after the conduit is finished by a suitable cast-iron or concrete cover, made loose so as to be removed readily in case it is desired to open the box for taking off services. Monolithic conduit has been laid under a great variety of street conditions and during all seasons of the year with perfect success and with a material saving in cost over the various pipe methods of duct construction.

Niagara Energy in Syracuse.

The energy reaching Syracuse from Niagara is transmitted over two separate three-phase, 60,000-volt lines from the generating station of the Ontario Power Company. It is received at a switching station, located at Solvay, a suburb, through which it passes directly at 60,000 volts to a converter substation of the Syracuse Rapid Transit Railway Company, and indirectly through stationary transformers to the 11,000-volt circuits of the Syracuse Lighting Company, and to the 33,000-volt circuits of the Rochester, Syracuse & Eastern Railway, the Syracuse, Lake Shore & Northern Railroad, the Syracuse & South Bay Electric Railroad and the Oswego River Power Transmission companies. The switching station proper contains two separate sets of three-phase, 60,000-volt, 500-amp Westinghouse oil-break switches, which are closed and tripped by solenoids receiving energy from a 220-volt storage battery. Both the incoming and the outgoing 60,000-volt lines are equipped with horn-gap lightning arresters, of which there are three to each wire. In series with each arrester is a cement resistor. The three arresters are given different adjustments of sparking distance and series resistance, from long gap with low resistance to short gap with high resistance; the latter, which handles the mild disturbances, is assisted by the other arresters in succession as the disturbances become more violent. The leads enter and leave the building by way of circular glass windows in the center of which is placed an insulating tubing surrounding the conductor.

The energy for the Syracuse Rapid Transit Railways Company passes over aluminum wires to the city limit, from which point it is conveyed for 11,000 ft. by plow-steel cable to a converter substation. This substation contains three oil-insulated, water-cooled, 1000-kw transformers for reducing the e.m.f. for application to the slip-rings of three 1000-kw, six-phase rotary converters, which deliver direct current at 550 volts for the railways of the city. The converters are brought up to speed by means of directly connected squirrel-cage induction motors and are connected in parallel when the proper speed is reached by means of automatic synchronizers. The above-described machinery is of Westinghouse manufacture. An old reciprocating steam-engine station containing direct-current generators is retained as emergency reserve and to carry peak loads.

The energy for the 33,000-volt circuits passes into a transformer-room containing four 300-kw Westinghouse single-phase, self-cooling, oil-insulated transformers, three of which are in service, with the fourth held in reserve. Even at the present time the load demanded exceeds the rating of the three transformers. A fifth transformer will soon be added, so that the two "reserve" transformers can be joined in open-delta to assist in carrying the load. With the latter arrangement a load

of 1400 kw can safely be carried continuously. The outgoing lines are provided with combined expulsion fuses and air-break disconnecting switches, and with aluminum-cell lightning arresters. Indicating devices serve to show to the attendant when the temperature of the transformer oil is excessive or a fuse has blown. The gap which separates the arresters from the lines is short-circuited at regular intervals in order to maintain the surface film in operating condition.

The energy for the Syracuse Lighting Company passes from the 60,000-volt oil switches through open-air disconnecting switches into an adjacent substation building, where the e.m.f. is reduced to 11,000 volts by means of three 1000-kw, water-cooled General Electric transformers. These transformers are placed in separate fireproof compartments and provision is made for emptying the oil from any transformer into a cistern when necessary. The circulating water is pumped out of and allowed to flow into an open-air cooling tank. A fourth 1000-kw transformer in its fireproof compartment is held as reserve. By means of busbars and disconnecting switches this transformer can readily be paralleled with either of the other three transformers, which can then be removed from service for repairs, etc. The outgoing 11,000-volt lines are equipped with multigap lightning arresters with shunting resistors of graded resistance, while motor-operated oil switches serve for protecting the circuits from overload.

At the lighting substation there are two 1000-kw motor-generator sets for changing the frequency from 25 cycles to 60 cycles, two 500-kw synchronous converters for delivering direct current and 32 oil-insulated, water-cooled mercury-arc rectifiers with constant-current regulating transformers for operating 1560 magnetite arc lamps joined in 32 separate series circuits. This apparatus was supplied by the General Electric Company. In connection with this substation equipment there is available for use during emergency and to carry peak loads two 1500-kw Curtis steam turbo-generators, three 500-kw reciprocating-engine generator sets and 25 series arc-lighting generator sets, some of which can be driven by motors and others by belts from line shafting driven by reciprocating engines.

The boiler equipment is rated at 7200 hp. Some of the furnaces are fed with coal by hand, others by automatic stokers, while a few of the furnaces are arranged for the use of oil fuel. The oil fuel is particularly advantageous for "stand-by" purposes.

Protective Features of a High-Tension System.

In an interesting paper presented before the Chicago section of the American Institute of Electrical Engineers, Mr. R. F. Schuchardt gave the results of experience with the protective devices used on the Commonwealth Edison system of high-tension underground transmission with rotary converter and frequency-changer substations. The system consists at the present time of three generating stations having a maximum continuous rating of 15,000 kw, 120,000 kw and 42,000 kw respectively, of 23 rotary converter (Edison) substations aggregating 54,700 kw in normal rating, nine frequency changing substations with 32,000-kw rating, and about 350 miles of three-conductor underground cable. Of the latter about 300 miles is operated at 9000 volts, the balance at 20,000 volts, which pressure is obtained from 5000-kw step-up transformers at a generating station. Eleven of the rotary converter substations also have storage batteries and there are in addition three large substations containing batteries only. The total battery rating at the one-hour discharge is 18,000 kw. A subsidiary 60-cycle steam plant with a rating of 2400 kw should also be mentioned. Energy is also supplied to 19 substations, aggregating over 80,000 kw, of the various elevated and surface railway lines. The three-phase generators are Y-wound and operate at 9000 volts between terminals. The neutral of the system is grounded. The substations are connected on the radial system, though a number of interconnecting lines are provided for emergency use. Fig. 1 shows diagrammatically the component parts of the system.

In the development of a suitable system of protection for such a system there is danger of providing so many devices that instead of protecting the system one is actually overloading it with danger points which may seriously impair the service. The watchword must be simplification. The system should be made thoroughly sound and use should not be made of protective devices that introduce complications or that are not a positive necessity. In other words, it is not how much protective apparatus should be installed, but how much can be avoided. This is the position of the Commonwealth Edison Company, and in the following will be shown how it is carried out and also the evolution to the present system.

The original transmission line, which was started in August, 1897, at 2250 volts, and which had a length of about three miles and fed energy to two 100-kw rotary converters, was provided with aluminum fuses in spring-expulsion blocks. The next year the voltage was doubled, but the fuses still continued in service, though pneumatically operated wood-vessel oil switches were then introduced on the line. About three years later, in February, 1902, the voltage was again doubled and alternators of large rating were installed. The transmission lines had increased to six in number, and remotely controlled, electrically operated oil switches were installed. The proper

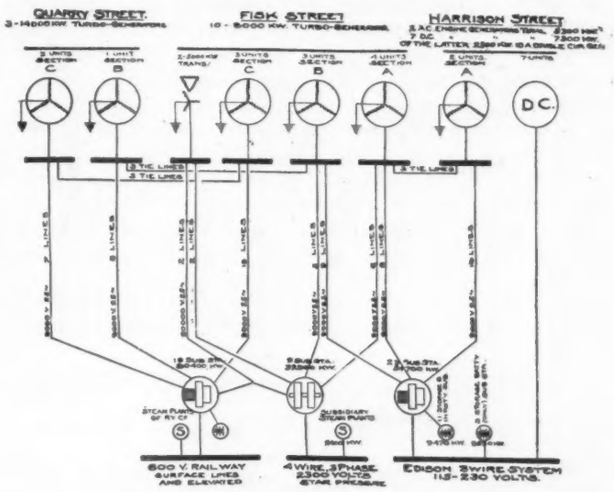

QUARRY STREET.
FISK STREET
HARRISON STREET
D.C.
600 V. RAILWAY SURFACE LINES AND ELEVATED
4 WIRE, 3 PHASE, 2300 VOLTS, STAR PRESSURE
EDISON 3 WIRE SYSTEM 115-230 VOLTS.

FIG. 1.—INTERCONNECTIONS OF QUARRY STREET, FISK STREET AND HARRISON STREET STATIONS.

protection for this system was the subject of much study, and finally the simple solenoid-and-plunger type of overload relay combined with a fixed time-limiting device was adopted. At the substation the relays were installed without the time-limit. The time-limit was originally set for six seconds, but experience soon showed that this was much too long and the setting was reduced to two seconds. Cable trouble, however, continued to cause quite severe disturbances and the fallacy of a fixed time-limit soon became apparent. It was, therefore, abandoned, leaving only the plain relay with practically instantaneous action.

The system grew rapidly and in 1903 the first two 5000-kw turbo-generators at the new Fisk Street station were put into service and by the next summer a third had been added and the length of the transmission lines was increased to a total of 68 miles. The necessity for obtaining selective action of the relays so that in the larger system the proper switches, and those only, would operate was, of course, recognized. The devices on the market at that time were few and none was very promising. Thus the plain overload relay still reigned alone. It was attempted to get selective action by having the setting of the relay at the substation end considerably lighter than that at the station end. Where a line was continued from one substation to another, a gradient was adopted for the settings of the relays at the various switching points, the heaviest setting being, of

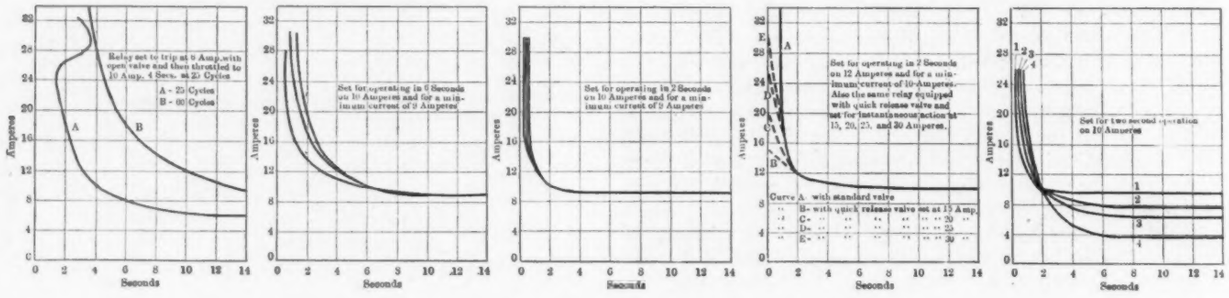
course, at the generating station. However, the current which flowed into a cable breakdown was never limited to that of the minimum relay setting and the general opening of lines resulting from cable trouble caused as much disturbance as formerly.

The demand for a selective action became more insistent, and experiments were started to develop a suitable device containing the desired features. The bellows attachment to the coil-and-plunger type of relay had been produced and when experienced proved it to be satisfactory it was adopted in Chicago. The effect of the bellows was to make the time of action of the relay inverse to the amount of the overload; moreover, with two bellows relays having equal current setting, but unequal time adjustment, the one with the shorter time adjustment would always open first when tested in series. The bellows relay was thus found to have features necessary for selective action. As it plays an important part in the solution of the protective problem its characteristics as shown in tests, and improvements prompted by experience, will be dealt with in some detail.

In the early bellows relays the plunger when drawn upward returned to its "at rest" position very slowly. An improvement was made by adding a quick-recovery valve. This valve was intended to prevent the plunger from being picked up by light swinging grounds, thus gradually bringing it to the contact position with an intermittent overload lower than its setting. On a system such as the one under discussion these intermittent overloads do not occur, and the quick-recovery valve on 25-cycle

The vibration at 25 cycles is due to the fact that this frequency is somewhere near the natural period of vibration of the suspended plunger. When during trouble the frequency of the system drops one or two cycles the chattering becomes more pronounced. When the valve is throttled down fairly far—for instance, for a six-second adjustment—then the retardation of action may be considerable. With light throttling—for two-second adjustment—the resistance to the rising plunger is comparatively low and the vibration does not become harmful. The probable explanation of the pumping is as follows: When the heavy overload suddenly comes on the relay the core is violently jerked upward, thus compressing the air in the bellows and the spring in the stem under the contact cone. A small amount of air is driven out of the orifice at the top, but when the current wave falls to zero there is sufficient energy in the compressed air and in the compressed spring to cause a recoil of the core. The inertia of this movement causes air to be drawn into the bellows through the quick-recovery valve and this is the weakness of that valve referred to above. When the current wave again rises the plunger meets a condition in the bellows similar to that at the beginning and this cycle is repeated for the successive waves. The closing of the relay contacts is thus greatly delayed or even hindered.

It was found during the investigation that when a relay is adjusted to operate in six or more seconds at its minimum current setting—that is, when it requires six seconds to operate when the current rises to the minimum setting valve and will


Amperes
Seconds
A - 25 Cycles
B - 60 Cycles
Curve A with standard valve
B- with quick release valve set at 15 Amp.
Set for two second operation on 10 Amperes

FIGS. 2, 3, 4, 5 AND 6.—TESTS OF BELLOWS-TYPE OVERLOAD RELAYS.

circuits actually introduced a weakness, as will be pointed out shortly.

In several cases of cable breakdown the line switch did not open as quickly as it should have done. Investigation showed that the holding screws for the short-circuiting bridge which is carried on the plunger rod of the relay were either entirely out or were very loose; in one case this bridge had moved so that it could not possibly have made contact. As these relays are examined daily, the only explanation for the loose screws was violent vibration of the relays at the time of overload. A series of tests was accordingly made to learn the reason for this behavior. In the newer relays received at that time a brass cone on the plunger rod replaced the contact bridge. This cone eliminated the loose screws, but not the vibration. The tests brought out the fact that on 25 cycles many of the relays would vibrate excessively and also pump when a current of about 25 amp to 30 amp was applied, the rated range of these relays being from 6 amp to 15 amp. The vibration and pumping greatly retarded the upward motion of the plunger, as is illustrated in curve *A* of Fig. 2, which is the seconds-ampere curve of a relay on 25 cycles. Of ten relays tested four had curves similar to *A* of Fig. 2. On 60 cycles very satisfactory uniformity was obtained and the curves were smooth and regular, as shown in *B* in Fig. 2, which was obtained on the same relay as *A* and with no changes in the setting. The excessive vibration is entirely absent at this higher frequency. The seriousness of this retarded action on 25 cycles will at once be seen when one considers its meaning, namely, that when a short-circuit comes on the line—a time when the switch should open instantly—it really opens more slowly than when an overload of only 150 or 200 per cent occurs.

not operate at all with a lower current—then there is considerable non-uniformity between curves of different relays on 25 cycles, as shown in Fig. 3. This lack of uniformity entirely disappears when the adjustment is made at two seconds—Fig. 4. The lesser time required to operate at excessive overload with a two-second adjustment is clearly illustrated in this curve. The 0.3 second minimum time shown here is about as short a time as can be obtained on the standard form of the relay. This shows the desirability of adjusting for the two-second value of the curve. However, the curve of Fig. 4 is not the ideal one for a protective relay. The desideratum for such a relay is to operate instantly when the overload is in the nature of a short-circuit and to operate only after several seconds if the overload, though dangerous if prolonged, is not of the short-circuit kind. As continuity of service is always the first aim, the switches should not be opened by an overload until it is positively unsafe to hold on longer. On the other hand, when a cable breaks down the switch should be opened instantly, for the breakdown—which usually is on one wire only, the neutral being grounded—will otherwise spread to the other wires and then the shock to the system may be very severe and the switches of sound lines may be opened. Where the load consists of railway lines occasional current rises may occur which would be dangerous if continued, but which last for only two seconds or less. The switch should remain closed under these swings, therefore the two-second point of the relay curve should be as high as is consistent with safety. Based on heating only, the theoretical curve would be that of an inverse square very similar to the curve of an ordinary fuse, and this is actually the curve of the relay when the minimum current setting is adjusted for a long-time period. The

condition just mentioned, that the relay act instantly on a short-circuit, requires that the curve come to zero time at and beyond a definite load. From this point it should drop gradually to the two-second value and then continue at a lesser slope until the minimum-current value is reached, which should properly be at as long a time as can be obtained on the relay. This minimum setting is fixed by the danger limit for a robust system or apparatus, a comparatively small factor of safety being applied on the principle that it is better to risk an occasional burn-out than to be frequently shutting down part of the service. The load at which the switch should open instantly is approximately twice that of the minimum current setting, the two-second point being about half-way between the two.

On the bellows relays received from the manufacturer it was impossible to obtain a curve giving the points just defined. This is due to the construction and the type of air valve used. One of the engineers of the testing department of the Commonwealth Edison Company designed a very simple device which, when substituted for the manufacturer's air valve, overcomes the trouble due to vibration and enables practically a zero time

FIG. 7.—BELLOWS-TYPE OVERLOAD RELAYS.

point to be obtained with the standard relay. The device is a combination of a needle valve and a pop valve; it is shown applied to a relay at *A* in Fig. 7. The standard valve is shown at *B* in Fig. 7. The effect of the new valve is clearly shown in Fig. 5, in which *A* is a curve of a relay with standard valve, and *B, C, D* and *E* the same relay with the new device, the quick-release part of which is set respectively at 15 amp, 20 amp, 25 amp and 30 amp. The two features, insurance against vibration-trouble and a practically zero time-point, recommend the new valve and it has been adopted for all 25-cycle bellows relays of the company.

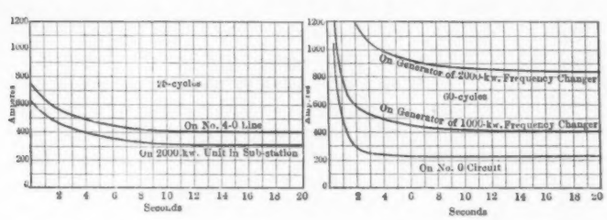
The method followed in setting a relay equipped with this new valve is as follows: The valves are first opened wide and the plunger is adjusted so that the desired minimum current will positively pull it to the contact position. The needle valve is then closed and the quick-release or "pop" valve is adjusted for instantaneous operation at the desired current value. The last step is then the adjustment of the needle valve for the two-second point.

In the discussion of the time action a distinction must be made between the time in which the switch will open after the overload comes on and the time required for the relay to close the tripping circuit. The time taken by the switch itself varies with the design of the switch. Tests on the oil switches used by the Commonwealth Edison Company have shown times varying from approximately 0.2 sec. to 0.6 sec. The trip switch will operate in about 0.03 sec. The ideal switch would open instantly the trip switch has acted. Because of the comparatively slow-acting switches the time setting of the relays should not be too high.

In describing the setting of a time-limit relay at least two points of the curve should always be stated, otherwise the description defines only the point stated and this may fit any number of curves. In Fig. 6 are shown four curves, any one of which might be meant if described merely as a 10-amp, two-second setting.

Having described the development of the relay itself, it is well now to discuss briefly its application and also that of other protective devices and features of the system.

In the generating station overload relays are used on transmission lines only. American engineers are practically unanimous regarding the undesirability of automatic devices on the generator switches. In some of the stations occasionally trouble has occurred at the generator. In every case the switchboard operator promptly disconnected the correct unit. The transmission lines with a few exceptions consist of three-conductor No. 4-0 cable. The relays on these lines are based on a continuous carrying capacity of 250 amp, which is 3900 kw at unity power factor. A 300 per cent load on this basis is considered sufficiently high for instantaneous action of the relay and 225 per cent load for two seconds. The minimum current on which the relay will operate is taken at 160 per cent of rated capacity. A No. 4-0 line may be loaded up to 4000 kw, and therefore the minimum setting is increased somewhat above one-half of the instantaneous setting. In the substations the line relays have been removed or omitted entirely. Instead, all of the lines feed energy to separate buses in the substation and are not ordinarily connected in parallel at that end. Dependence is thus placed on the relays of the units themselves for disconnecting the line from the load in case of trouble on that line. A 2000-kw unit, either rotary converter or frequency changer, on which the full-



FIGS. 8 AND 9.—TESTS OF BELLOWS-TYPE OVERLOAD RELAYS.

load input current at unity power factor is 155 amp, has its relays set at 310 amp minimum, 465 amp in two seconds and 620 amp instantaneous. Smaller units are set on this same basis in proportion to their rating. In Fig. 8 are shown the curves of a No. 4-0 line and of a 2000-kw substation unit. The settings just described were recently adopted after a careful study of the entire situation. The previous line setting was 500 amp, or 200 per cent load in six seconds, the minimum current then being about 490 amp. This is the setting which was found on some relays to have unreliable action on heavy overload, as was the case in curve *A* of Fig. 2.

The relays on the 60-cycle circuits and generators of the frequency changer substations do not have the instantaneous attachment, and the overload settings are higher in proportion than on the 25-cycle relays. The principal reason for this difference is that the short-circuit characteristics of the generators are different from those of the 25-cycle turbo-generators and the possible energy which can flow into a short-circuit is not sufficient to endanger the machines. Moreover, on 60 cycles the relay acts fairly promptly on excessive overloads. The e.m.f. of these 60-cycle, four-wire, three-phase generators is 4150 volts between wires, and their full-load rating is based on

75 per cent power factor. A 2000-kw generator would thus be rated at 372 amp at full load. On this unit the relays are set at a minimum of 840 amp and 1200 amp for two seconds. Other sizes of 60-cycle generators have their relays set similarly in proportion to their rating. The 60-cycle circuits, which are of No. 0 conductor and partly overhead, have their relays set at 225 amp minimum and 300 amp for two seconds. The full scale ammeter reading on these circuits is 150. These curves are shown in Fig. 9.

The bellows relays connected as just described constitute the entire protective apparatus connected on the alternating-current part of the system. In the new zone being reached by the 20,000-volt lines new problems will be encountered. Some of the substations will at the beginning probably be joined on the "ring" system and then the straight time-element overload-relay protection, with which the first of these lines to a single substation has been equipped, must be modified. This problem is being anticipated now and it would be readily solved if a reliable adjustable, alternating-current, reverse-power relay were obtained. It is possible that a scheme somewhat similar to that devised in England by Messrs. Merz and Price will have to be adopted.

On each rotary converter there is attached a speed-limit device set to trip the direct-current circuit-breakers when the speed reaches from 12 per cent to 15 per cent in excess of normal. These devices, which are of the ordinary mechanical centrifugal-switch type, have proved quite satisfactory. The rotary converters located in the basement of down-town office buildings are equipped in addition with direct-current reverse-power relays operating on the direct-current circuit-breakers. This departure from the rule of "least protective devices" is here made for reasons of policy. The relay is of the ordinary armature-and-magnet type, the magnetic circuit being closed at a contact at the direct-current ammeters. It might be added that each steam turbine is provided with a speed-limit device which closes a butterfly valve in the steam supply at a 10 per cent excess of speed.

The experience of the Commonwealth Edison Company with the various overload relays and with the different time settings on the bellows type leads us to the belief that the present adjustments will give a maximum of protection or, in other words, a minimum of disturbance during trouble in the system. Since changing from the six-second setting and replacing the air valve, the few cases of cable trouble which have arisen produced no more than a slight jolt on the system. If subsequent experience dictates further changes they will undoubtedly be in the direction of higher current settings. The action of the relays in the substations has been carefully watched. In every case of line trouble the units feeding energy from the bus connecting with the damaged line have been automatically disconnected either by the speed-limit device or by the alternating-current overload relay. In the substations which have the reverse-power relays, the circuit-breakers have at times tripped during a system disturbance while units without these relays continued to run. The advisability of having the reverse-power relay operate only the direct-current breakers has frequently been demonstrated when, during a heavy system disturbance, the alternating-current switch remained closed and the unit continued to run. When equilibrium was restored only the closing of the direct-current switches was required to replace the unit in service.

The operation of the high-tension system in sections was again started more than two years ago, and the advantage and great importance of such operation in limiting the extent of a disturbance on the system have been emphasized on several occasions. At present there are only two sections, but during the heavy winter loads another division is made, so that there are then three sections. The independent operation of the transmission lines at the substation end permits the omission of protective devices at that point. During emergency operation the lines may be in parallel at times, but this happens too infrequently to have any weight in the problem.

Of the central-station companies in the five largest cities of the United States the Chicago company is the only one that operates with a grounded neutral, but among the large railway companies the practice of grounding the neutral is common. Originally every generator was grounded. When the four-pole, 8000-kw units were installed, the neutral cross-current between them and the six-pole, 5000-kw units was found to be undesirably high, so that a resistance was inserted in the neutral of the new units. Incidentally this arrangement gave an opportunity to study the effect of a neutral resistance. Experience thus far has not been very decided either way. With the growth of the system and the addition of large units it was found that the effect of cable breakdowns increased in severity and therefore the grounding of all units was discontinued. The advisability of installing reactance coils in series with each generator is now also being seriously considered; in fact, a trial installation will soon be made. At present the neutral is grounded on one unit of each section, and the neutral bus of each section is connected to the ground bus through a 2.5 ohm resistance. There is as yet much difference of opinion among engineers as to the most desirable method of operating in this regard. Unanimity of opinion will not be reached until extended experience with each method has definitely pointed the way. However, in order to profit by that experience it is necessary that no opportunity be missed to study in detail every case of system trouble, and to record all facts and conditions which have any bearing whatsoever.

DISCUSSION.

Mr. L. L. Elden, of the Edison Electric Illuminating Company, of Boston, in discussion of this paper said that the experiences of his company with protective apparatus had been along the lines indicated by Mr. Schuchardt. Trouble had not been as serious as in Chicago, due, no doubt, to the smaller size of the system. Reverse-current relays are used only on alternating-current generators for single purposes. They are adjusted for 50 per cent reverse current and will operate at 70 per cent normal voltage. Bellows-type relays are used on transmission lines from the main generating station, adjusted for 600 amp with three seconds time limit. At the substation ends of these lines the bellows-type relay is also used, but with a lower adjustment. These adjustments in time and ampere capacity have been found to work out very satisfactorily in obtaining selective action of the relays on individual lines to each substation. In the substations where motor-generators are installed for conversion of current for the three-wire, direct-current system, instantaneous overload relays are used on the alternating-current side of the motor-generators. These are adjusted to three times the normal current capacity of the motors. On the direct-current side of such sets circuit-breakers are adjusted to twice the normal ampere rating of the direct-current generator. These adjustments satisfactorily take care of fluctuations caused by synchronizing or momentary disturbances on the direct-current system. These motor-generators have both synchronous and induction motors. Bellows-type relays are used on the high-tension side of the static transformers, being adjusted to three times the normal rating of the bank of transformers they protect. Instantaneous overload relays are used on all distributing circuits, whether single or three-phase. Troubles with the relay-type protective apparatus have been mainly confined to details, such as hardening of the bellows and clogging of air-valve passages. Frequent adjustment and inspection prevent such troubles. The comparatively excellent operation of the bellows-type relay on 60 cycles as compared with 25 cycles, as shown in Fig. 2 of the paper, probably largely explains the Boston freedom from difficulty on 60 cycles. Nevertheless, the action of the relay with the new attachment commends itself very strongly. The practice in Boston has been to operate the alternating-current system as a unit, but the company has seriously considered subdividing the system on the lines followed in Chicago.

Mr. W. G. Carlton, superintendent of power of the New York Central & Hudson River Railroad, discussed the operation of a system in two sections not connected, as against operating the entire system as one in synchronism. The operation in two

sections means an additional chance for trouble, because of mistakes in switching and also means that more generating capacity will ordinarily be kept in service than with one system. On the other hand, the one-system method has the objection that any short-circuit occurring in or near the power station is more likely to produce serious results. Short-circuit troubles are more severe the greater the capacity of the machines in service. In large stations busbar chambers in switch-rooms should be left with openings sufficient to provide for the rapid expansion of air due to heat liberated from short-circuits.

Mr. S. B. Way, of the Union Electric Light & Power Company, St. Louis, stated that he had found the same defects in bellows-type relays as were mentioned in Mr. Schuchardt's paper. The addition of the pop valve to the relay bellows produces just the desired effect, and his company intends equipping all of its bellows-type relays on 25-cycle lines with this device.

Mr. W. L. Abbott compared the result of short-circuits on a large direct-current lighting system with those on an alternating-current system. Whereas a short-circuit on the direct-current system could be burned off leisurely and without noticeable disturbance to the system, it was soon found with the higher voltages of the alternating-current system that the entire energy from all generating apparatus and storage batteries was all poured into the one point of disturbance, resulting in the general disorganization of the service. After recovering from their astonishment at the apparent delicacy of the new system everyone set to work devising protective devices. Naturally, the systems were loaded up with devices of such number and design that instead of protecting the system they only added further points of danger. It is now a question of the simplification of these devices.

Mr. F. A. Vaughn, of the Milwaukee Electric Railway & Light Company, described a relay developed there for the protection of constant-current series arc light systems against trouble due to open-circuiting of the outside lines. When the circuit is opened, a high potential is developed which usually means one or more breakdowns in the cable or elsewhere. With this relay, when the circuit opens there will be a jump across a spark-gap placed at the terminals of the circuit and the current flowing across that gap also flows in series through the windings of a relay. This relay raises a plunger that closes the gap permanently and short-circuits the arc circuit.

The Cost of Underground Conduit Systems for Electrical Distribution.

By Sydney W. Ashe.

In an article which appeared in the issue for June 3 various types of conduits and manholes for underground circuits were described. The present article deals with a recently developed junction box and cost data are discussed in detail.

1908 Junction Box.—The function of a junction box is to receive the feeders from the manhole and to distribute the electrical energy to the distributing mains, the separate mains being equipped with copper fuses in the junction box. An excellent improvement in junction-box construction has been recently brought out to supersede the Edison stub junction box. It is the purpose to locate this box near the manhole so that two sets of pipe connections may connect the junction box directly to the manhole; feeders and distributing mains may then enter the junction box, irrespective of their size, through these uniform connecting pipes. Comparing this box, Fig. 1, with the stub junction-box it may be noted that the box is rectangular in shape, having a maximum width from center of box to side of top of manhole of 2 ft. 2.5 in. The stub connections on the side of the box are of pipe 3⅜ in. in outside diameter, and, as previously mentioned, of uniform size so that any feeder may enter directly from the manhole. Mounted upon double fiber supports in the top of the 1908 junction box extends a double rectangular bus for the 240-volt service, in place of the rings in the old type of stub junction-box. The neutral feeder does not enter the box, but is joined directly to the distributing mains. Between the two buses is mounted a projecting fiber support so as to prevent a workman's tools from slipping over and thus short-circuiting the system when he is adjusting the fuses. Mounted upon the top of this strip of insulation are binding posts for the pressure leads which extend to the substation to indicate the potential at the point of distribution. Another important feature in connection with this box is that all of the terminals of the same potential come

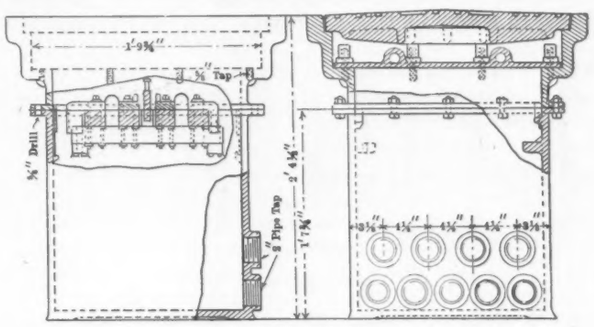


FIG. 1.—JUNCTION BOX OF 1908 TYPE.

to the same side of the insulation support, thereby completely separating the positive and the negative wires. With the old type of stub junction-box it was necessary to connect a certain feeder in a certain place in the box. This trouble has been obviated in this new box by having the terminals of all lugs, irrespective of size of cable receptacle, of the same dimensions so that any feeder may be connected to any part of the bus.

Service Mains.—The service mains are installed in the street through underground fiber conduits surrounded with concrete. Should occasion arise when it is necessary to reinforce these fiber ducts, iron rods are embedded in the concrete, as shown in Fig. 2. These conduits terminate in manholes so that the distributing mains may come from the junction boxes nearby to the distributing ducts. These ducts pass down a street, the conduit system being interrupted at frequent intervals by service boxes installed for every five or six houses. From the service box, iron-pipe conduit enters the cellar in the customer's premises. The details in connection with these service connections have been previously mentioned. Referring to Fig. 3 it may be noted that the internal dimensions of the service boxes are not very large, being of sufficient size merely to accommodate the cables and to allow the proper connections to be made. When fiber ducts are laid unprotected a special lining of concrete is employed. This is for light sidewalk construction, concrete not being used except for the joints. The standard F_3 service-box head is used wherever possible, being supported on 10-in. side walls with 3-in. bottom of concrete. (See Fig. 3.) The service boxes do not have individual sewer connections, but they should be graded so that one box when partly filled with water will flush into another, and so on down the street until the last one empties into a manhole where there is a sewer connection, the water passing through the fiber ducts between junction boxes. The service

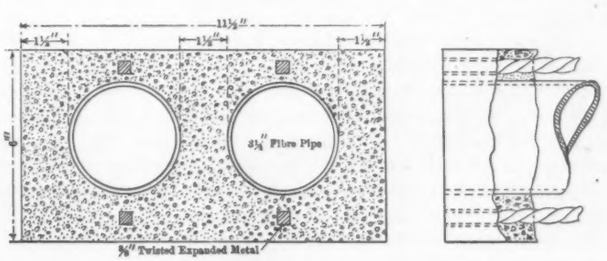


FIG. 2.—REINFORCEMENT FOR FIBER PIPE.

wires coming from the customer's premises are not fused in the service boxes, but are soldered directly to the service mains. A pocket is built in the sides of the service box, as shown in Fig. 3, and the cables are supported with clamps to wooden uprights. When making a joint in a cable great care must be exercised. With a large feeder, for instance, paper-insulated, both ends of the cable to be joined are bared for a distance of 3 in. A tinned copper connector is slid over both ends of the feeder and molten solder is poured over the joint. While the joint is hot rags are used to wipe off the excess of solder. When the joint has cooled it is wrapped with paper tape which has been previously boiled in paraffin until the insulation is as

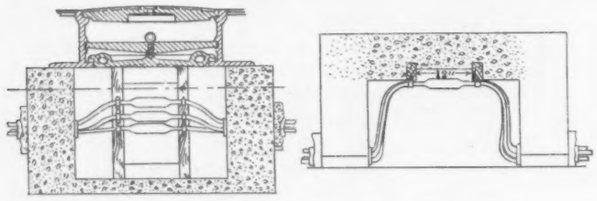


FIG. 3.—ARRANGEMENT OF SERVICE BOX.

thick as that of the original cable. The joint is then covered with a lead sheath of much greater diameter (shown in Fig. 3) and the ends of the sheath are soldered to the lead. This sheath has been previously slid over one of the cables before the joint was made. A small hole is then punched in this sleeve and it is filled with insulating compound, the opening being closed up and soldered. This form of joint is so satisfactory that when trouble occurs on the underground system it is usually due to some defect in the cable instead of in the joint.

COST DATA.

The element of cost is such a variable quantity—changing with so many variable factors, such as location of work, the relations between demand and supply, the general prosperity of the times, the demand for labor—that it is questionable whether values given at one time can be used at another time except in making approximate estimates. The values given apply to general conditions in New York on Oct. 1, 1907.

Cable.—Three-phase cable, paper insulation, 250,000 circ. mil, lead sheathed, costs $1.36 per foot, the length being made from 200 ft. to 400 ft. according to order. The hauling of cable through the ducts costs from $0.05 to $0.06 per foot, depending upon the length of the cable, being the greater for short lengths.

Vitrified Conduit.—Four-duct vitrified conduit costs $0.0525 per duct-foot delivered, 5 per cent to be added for storeroom handling; 3-in. fiber conduit costs $0.045 per duct-foot, and 3.5 in. costs $0.0525 per duct-foot.

Subway.—Six-duct subway costs $0.50 per trench-foot, including excavation, filling, laying duct, concreting, wrapping joints with muslin. To be added to this is $0.15 per trench-foot for framing, making a total cost of $0.65 per trench-foot complete.

Replacing Asphalt.—The price per square yard for replacing asphalt varies from $2.70 to $4 depending upon the original cost of installing, and upon the length of time of unexpired contract. The replacing work is done by asphalt companies. It might be stated here that in letting the original contract for asphalting a street, the contract usually covers maintenance for a period of from 5 to 10 years. The longer the term of contract obviously the better the asphalt must be laid. As to amount of charge for replacing, suppose that asphalt has been laid on a 10-year contract and that two years of the unexpired contract remain when the street is opened, it would not cost so much to renew the asphalt as if it had to be renewed when it had been in place only three years. Each year the asphalt throughout the city in large places like New York is inspected and the results are published in book form by the city for each borough and are distributed to the public-service companies. From this book can be determined for any street the cost to replace the asphalt. Quite recently a new system of making a uniform charge for replacing asphalt has been introduced.

Manholes.—Excavation for manholes costs $1.25 per cubic yard, the amount of excavation varying from 12 to 18 cu. yd. for a manhole 6 ft. deep. Concrete costs $6 per cubic yard; allowing for shrinkage and waste the amount of concrete required varies from 7 to 10 cu. yd. where concrete manhole construction is used instead of brick. The cost of a manhole head depends largely upon its weight. A round head 12 in. in depth weighs about 1800 lb.—intended for use with cobble and granite—costs $0.0214 per pound, making the total cost slightly over $40. What is known as an F_3 head weighs 1240 lb.; and an F_4 head, 6 in. in depth, intended for asphalt pavement, weighs 1040 lb. The total cost of a manhole is usually divided into excavation costs, framing and setting of frames which cost from $10 to $15, setting of head which costs $6 and miscellaneous costs for I-beams, cable rocks, etc. The average total cost for a manhole is about $150.

Service Boxes.—The average cost of a service box of the F_3 type is $38.50.

Sewer Connection.—The average cost for installing a sewer connection is $17.50. The system used is to let the contract for the sewer connections to a licensed plumber, as is required by the city ordinance. In letting the contract it is a good plan to have a fixed charge whether the sewer connection is long or short. With each sewer connection must be installed a trap to prevent the sewer gas from entering the subway; a 4-in. trap costs $6.

Service Connection.—The average cost for installing a customer's service connections is supposed not to exceed $60. In reality it varies from $50 for a small connection to $300 for a 500,000 circ. mil connection.

Junction Boxes.—A 6-stub Edison junction box, type 93, for feeder and main, costs $372.40. A 4-stub sub-feeder junction box, type 93, for feeders and branch feeders, costs only $315.88.

Cartage.—The cost of cartage and handling depends upon the local cost of labor, two men being required in addition to the truck and driver. A fair price for truck and driver is $5; for each laborer, $1.75. A two-horse truck can carry 2500 ft. of fiber conduit, or 70 pieces of 4-duct multiple tile 3 ft. long, per load. At five loads per day the cost of cartage and handling would be $0.00068 per foot of fiber, or $0.00202 per foot of tile.

Paving.—The cost of paving is based on the area paved The value per square foot ranges from $0.30 to $0.75 for cobble, $0.90 to $2 for granite on sand, $2.50 to $5 for granite on concrete, $2.50 to $7.50 for asphalt.

Trenching.—A fair average price for trenching, back-filling and cartage of excess material is $0.75 per cubic yard.

Laying of Conduit.—Common laborers may be used in laying fiber; three men—two in the ditch and one on the bank—

COST OF A 4-DUCT SUBWAY.

	Multiple tile.	Single tile.	3x¼" fibre.	3x⅛" fibre.
Cost of ducts at factory	$0.16	$0.16	$0.18	$0.148
Freight—fibre, 30c. per cwt.; tile, 22c. per cwt.	.0704	.0704	.0144	.0144
Cartage and handling to trench	.008	.008	.0027	.0027
Paving, at $1.50 per sq. yd	.239	.2573	.2207	.2141
Trenching, backfilling, cartage excess material, at 75c. per cu. yd	.1299	.1457	.1163	.1110
Laying of conduit	.01	.012	.004	.004
Cloth for joints	.0052	.0244	....	....
Lumber for sides	.0012	.0012	.0012	.0012
Breakage of conduit 5% tile; ½ of 1% fibre	.0015	.0015	.0009	.0008
Concrete, $6 cubic yard	.2222	.2126	.2310	.2195
Mortar, $8.50 cubic yard	....	.0109	....	....
Supt. and incidentals, 5% of total	.0428	.0457	.0385	.0357
Total = Cost per trench foot	.9002	.9597	.8097	.7514
Total ÷ 4 = cost per duct-foot	.2250	.2399	.2024	.1878

are sufficient for one gang. Tile requires one tile layer and three helpers; the pay of a tile layer averages $2.50 per day. In general multiple tile costs to lay per duct-foot $0.0025; single tile, $0.003; fiber, $0.001.

The values in the above table have been based on the detailed estimates discussed previously.

Concrete.—Mixtures of concrete vary according to the location and the relative prices of the constituents. A mixture of one part of cement, three parts of sand and five parts of broken stone would cost as follows:

1 cu. yd. of cement—6.75 bbls., at $2.00	$13.50
3 cu. yd. of sand, at $1.50	4.50
5 cu. yd. of broken stone, at $3.50	17.50

Since the sand and cement fill voids in the stone, the final volume is 5 cu. yd., which costs $7.10 per cubic yard. The mixing of this material will cost from $0.35 to $0.50 per cubic yard.

Mortar.—The cost of mortar varies according to the cost of cement and sand. A mixture of one part of cement and two parts of sand, which is generally used, costs $8.25 per cubic yard, to which must be added approximately $0.50 for mixing.

CENTRAL STATION

MANAGEMENT, POLICIES AND COMMERCIAL METHODS

Changing Denver Window Lighting to Tungsten.

Some interesting figures on 18 window-lighting installations in Denver which have been changed from common carbon-filament lamps to tungsten are given us by courtesy of Mr. C. N. Stannard, secretary of the Denver Gas & Electric Company. Of these 18 installations there is a net gain to the company of $768 per year in gross revenue, or 26 per cent. The old lamps paid an average of 6.2 cents per kw-hour, and the new installations pay 9 cents per kw-hour. The old installation wattage was 20,776, and that of the new is 18,120, a decrease of 9.4 per cent. The candle-power of the old installation was 6022 and that of the new installation is 14,016, a gain of 132 per cent. Out of the 18 installations, two show losses in gross revenue, so that the net gain came from the other 16. The consumer buys and maintains the tungsten lamps. The company sells tungsten lamps at the following prices for clear bulbs: 25-watt, 65 cents; 40-watt, 85 cents; 60-watt, $1.05; 100-watt, $1.40; 250-watt, $2.75. The energy for window-lighting installations is sold on a Doherty readiness-to-serve rate. Under this rate 15 cents per month per 16-cp lamp as a flat readiness-to-serve charge is made in addition to an operating charge of 5 cents per kw-hour. The readiness-to-serve charge is figured on the basis of candle-power, so that the tungsten lamps pay a higher readiness-to-serve charge per watt connected, which accounts for the increased revenue per kw-hour noted.

Grounding of Secondaries Through Lamps.

Grounding of secondary lighting circuits by the grounding of the neutral wire of three-wire circuits or one wire of two-wire circuits has come to be generally accepted, although not universally practised as the best method of making interior lighting circuits safe from high voltages caused by crosses with high-tension lines outside the building or by defective transformers. In one Western city where there is considerable competition in the downtown district between two rival central-station companies, one of the companies wished to insure itself against fatal accidents to consumers by this accepted expedient of grounding the neutral of its secondary circuits. However, much of the interior wiring in the downtown district was in very bad condition, and after the grounding of the neutrals it was a frequent occurrence to find a consumer's place in darkness because defects in the wiring had caused a short-circuit. Of course, if wiring is in such a precarious condition as to cause short-circuits when one side of the circuit is grounded, it is not fit for continued use, and the occurrence of such troubles is no argument against the practice of grounding. Nevertheless, these troubles were annoying to the central-station company, especially in competing with a rival which did not make it a practice to ground its neutrals. In order to make it possible to give continuous service without interruptions and to give the company some warning, the expedient was adopted of inserting a lamp in series with the ground wire where transformer neutrals were grounded. This lamp was placed high on the pole. The lighting of one of these lamps was then an immediate warning to the company's trouble-men that either there was a cross between high-tension and low-tension wires, or a ground on the ungrounded side of the secondary circuit. The trouble could then be found and remedied without putting a consumer's premises in darkness without warning. As a temporary practice, if the lamps in the ground wires are closely watched, this is much better than running without grounds altogether, although it cannot be considered a desirable way to operate permanently. As an indication of the bad condition of the wiring in the city referred to, a number of cases occurred where consumers attempted to replace fuses with heavy copper wire, one side of the circuit being grounded intentionally at the transformer and the other side of the circuit being grounded accidentally by contact of a wire with a gas pipe. By the insertion of these heavy fuses a sufficient arc was established to melt through the gas pipe and start a fire.

Sign-Lighting Business Criticized.

At the recent Dallas convention of the Southwestern Electrical & Gas Association a discussion on the profitability of electric sign-lighting business developed some doubt as to the desirability of a sign load. Mr. F. M. Legge, Jr., of Galveston, did not favor pushing sign-lighting business, because it was a peak-hour current consumer and therefore might be unprofitable. Also, if a customer is using light for other purposes the addition of sign lights might be an undue burden. It would be far better to use equal energy in getting additional motor load or regular lighting customers. The company, in other words, should show the customer that it desires to give him all it can for his money rather than lead him to think that the company tries to get all the money it can and give the customer as little as possible in return. Mr. H. S. Cooper, of Galveston, said that one bad feature of sign lighting was that it resulted in selling current at cut rates and no business could remain strong if that was done. The customer wonders why he should pay 10 cents for current inside the store and 5 cents for that used in a sign outside, and then he complains. Mr. Legge said that sign lighting in Galveston was done at regular rates and the customers furnished the installation and service wires to the pole. By close accounting of the current cost for each hour of the day, he had found that while current could profitably be sold some hours of the day at 1 cent per kw-hour, at others it would not be profitable to sell it at 10 cents per kw-hour on account of the generating cost. Mr. Jas. C. Woodcome, of Dallas, was not attracted by sign lighting for several reasons, and particularly if rates must be reduced to get the business. It was a short-time load at peak hours, and the generating cost was then at a maximum. Sign lamps, although small, cost as much as larger ones and made a much smaller load. He did not favor making a special rate on any sign unless it were to burn all night. Mr. Wm. G. Carroll, of Beaumont, said that his company was doing considerable sign lighting. The company purchased the signs and spread their cost over one or two years in addition to the regular monthly lighting bills, for which the regular sliding scale rates were charged. The store lights usually were turned out on or before 7:30 p. m., but the signs burned until 10:30 p. m. and 12 p. m., so this special sign business lengthened the peak hour and increased gross receipts. He favored the sale of current for sign lighting and agreed with his customers that illuminated signs were excellent advertisements.

Co-operative Vacuum Cleaning.

All central-station companies which operate day service in residence districts should be interested in ways of furthering the popularity of vacuum cleaning by electric motor-driven machines. Many central-station companies have purchased small outfits of this kind which are rented to the users at prices ranging from 75 cents to $2.50 per day. Machines rented in this way are mostly of the smaller types which can easily be used by any housekeeper with a few simple instructions, and they are doing much to make electric service popular.

A plan which has been successfully worked at Beverly Hills, a suburban district of Chicago, where a heavier machine is used, may be of interest. The machine in this case was purchased by a man of established reputation who was making a regular business of house and carpet cleaning in the community. He saw that a vacuum-cleaning machine of sufficient power to do fairly heavy work would be a good business proposition and would prove popular with his customers. After investigation of the conditions it seemed best to purchase as heavy a machine as could be handled by one man and taken around the community on a strong hand-cart. The machine selected was one made by the Milwaukee Vacuum Machinery Company, equipped with a ¼-hp, single-phase, 60-cycle motor driving a triplex pump. The pump has grease-packed pistons and the air is drawn through two centrifugal separators and one dust bag or strainer. The weight complete is something less than 200 lb. A vacuum as high as 18 in. or 20 in. can be obtained, but the relief valve on the machine is ordinarily set for 10 in., this being the maximum desirable for ordinary work.

The money for the purchase of the machine was advanced by residents of the community who wished to secure the services of the machine. To those who thus advanced money a receipt was given which stated that the person named in the receipt was entitled to the services of the machine at 60 per cent of the price charged to non-contributors. In this way an inducement was offered to householders to loan or advance money for the purchase of the machine. It was agreed that the rates to contributors for the use of the machine should not be over $3 per day for machine rental, in addition to which the owner and operator was to receive $3 per day for his services, which was the regular rate he had been getting for his work before he purchased the machine. About $300 was raised in this way from persons advancing money. The operator and owner receives cash for his personal services at the rate of $3 per day, and the remaining $3, which is charged for the use of the machine, is credited to the contributor. Most of the contributors advanced $10, although a few advanced more.

The rate to non-contributors, in accordance with the agreement, is $5 per day for the use of the machine and $3 for the services of the operator. The machine was put in operation about March 15, 1909, and has been in constant use ever since. It can be used, of course, only in houses having electric service and consequently is proving a powerful popularizer of electric service. The amount of dirt removed from a house in a day's work is usually a shock to the housekeeper.

The machine is taken from house to house in a heavy cart, easily wheeled by one man. As the machine is entirely too heavy to be taken up and down stairs by one man, 50 ft. of vacuum hose is provided. A couple of planks are carried on the cart with the machine, and the machine is rolled from the cart into the front door or on the porch over these planks. Electric current is obtained from any lamp socket. On account of the high starting current required, the circuit on which the machine is used must be equipped with 15-amp fuses, consequently on connecting up for work, the first precaution is to see that the main line or service fuses are of at least 15-amp capacity. The lamp is turned on in the socket from which it is desired to obtain current for the motor, and the operator determines, by unscrewing the fuses in the branch fuse cut-out cabinet, which circuit supplies that socket. The regular fuses on that circuit are taken out and 15-amp fuses temporarily substituted for use while the motor is being operated. Upon leaving the house, the fuses are left in the condition in which they were originally found.

The Essentials of Electrical Salesmanship.

By Eugene Creed.

In a recent article by one of New York's great merchants it is stated that a salesman's personality has much to do with the marketing and distribution of commodities; that, in fact, the "personal factor" is paramount in merchandizing. The writer of the article in question is a retail merchant. The public goes to his store without solicitation other than that which is called advertising. After the advertising has aroused interest, then the salesforce must turn the interested ones into actual buyers, not for the time being, but as long as commodities are for sale. Only through the pleasing personality of the salespeople does he believe it possible to gain and retain trade.

In marketing the product of an electric lighting and power company it is necessary to arouse the interest of the public through some agency. The most effective means are through advertising in the daily press or by circularizing through the mail (direct by mail advertising) and personal solicitation. The whole- or half-page announcement is of proved assistance to the retail merchant, and in like proportion is the whole or half column to the central station, not forgetting the well-printed booklet. Advertising opens the door to the salesman and increases his sales record.

Through the work of able, conscientious, painstaking, tactful, intelligent and "likable" men only is a corporation having a commodity to sell best able to introduce its product and afterward hold its customers. A "likable" man is he who impresses you as a pleasant, honest fellow, who is careful never to violently disagree with you, and who, though he may be as intellectual as Bacon, as great a mathematician as Newton, or as brilliant an engineer as Steinmetz, carries himself as an ordinary individual who has the interests of his prospects at heart as well as those of his company. In approaching a prospect this "likable" man states his business courteously, uses his keen knowledge of human nature in judging whether the prospect is in a mood to listen to the many virtues of electricity as an illuminant, a heating agent, or as a driving agent, and hear of its superiority to wind, water, steam or gas.

The electric company's solicitor should have a very broad knowledge of the use of gas as a heating, lighting and driving factor. The gas men are not asleep. The great argument in favor of the gas engine is its economy in operating. The gas engine, so the manufacturers claim, can be operated for less than 2 cents per hp-hour, while the electric lighting company cannot sell energy at so low a rate. Not once but a hundred times in a month has the writer been told that gas is so much cheaper than electricity that the latter agent would not even be considered.

An answer to such an assertion is imperative. When a man is interested to the extent that he will argue the price with a salesman he is a good prospect. He must be answered intelligently. Now, I submit the following arguments against the gas engine:

The gas engine of a very popular type has over 140 parts. These 140 parts are subject to wear and tear. The internal-combustion engine signs its own death warrant just as soon as the first explosion takes place. It pounds itself to pieces. The engine requires skilled attention. It is obtaining money under false pretences to say that the gas engine can "run itself."

Let us quote a catalog of a leading manufacturer: "To start the engine: 1. Light the lamp and place it under the igniter ball. 2. Oil bearings of engine all around. Fill oil wells, draw oil from crank case by opening cock and rocking wheels back and forward several times. Allow lamp to burn with a strong flame about 15 minutes, when the igniter should be hot

enough (a dull red heat)." Following are three additional directions, all to start a gas engine.

In favor of the electric motor are very few parts, and in the case of the induction motor but two bearings. No pounding, snorting or wheezing, no water-jacketing, and, to start, simply throw a switch.

No customer appreciates the convenience and economy of electricity until he has tried it, and there are many who hesitate a long time before making a trial. These are the people the "likable" salesman must convince. After electricity has been used the price will gladly be paid rather than go back to the old troubles with gas. Admitting the lower cost per hp-hour of the gas engine, nevertheless the convenience and durability of the motor are unanswerable arguments in its favor. The man who has the knowledge of the superiority of his wares is the man who will convince his prospect, not only in the case of the gas engine, but in all similar matters.

A salesman employed by one of the leading central stations was met by a producer-gas-plant argument lately. The producer-gas-plant manufacturers claimed that the cost per hp-hour would be but 1 cent. Naturally the prospect told the salesman of the offer of the producer people. Salesmanship was necessary here. It was not a case where psychology could get in its fine work. It was strictly a matter of price. Common-sense and knowledge were the essential requisites. The argument against the producer was the necessarily large investment for the plant, the labor cost of operation and the utter impossibility of operating a producer-gas plant economically on intermittent load. This was clearly and forcibly shown, with the result that no producer plant is going to be installed at this particular point.

It might be interesting to give a brief sketch of the visit a central-station solicitor recently paid to a planing mill. The owner was a sharp old fellow. When the subject of electric power was broached—the prospect, by the way, was using steam—immediately came the reply, "But what am I going to do for heat?" Electric heat was out of the question, so a low-pressure boiler was suggested, and arguments were offered showing that the present steam plant required skilled attendance at a high cost, a waste of money six months in the year when steam for heating was not required, while with the electric motor and a low-pressure boiler used only during the winter months the labor cost was saved, and the plant operated as satisfactorily, yet more economically.

In 15 years steam power has increased in manufacturing but 136 per cent, while electric power has increased 7292 per cent, and a considerable portion of this steam-engine increase is for driving electric generators.

In putting forth the arguments suggested it is imperative that all the faculties of the salesman be thrown into the work. If the salesman is the "likable" fellow all the more impressive will the effect be upon the prospect. An earnest, whole-souled, telling address, a forceful and logical way of stating the case, readiness to combat rebuttal arguments, and to clinch his own with facts and figures, are the essentials of a salesman.

One danger of fervid salesmanship was recently told by Mr. C. C. Hoyt, the prominent Boston shoe manufacturer, to a class of young men of the Tuck School of Administration and Finance of Dartmouth College:

"Many of the younger men, in presenting the merits of their lines, as salesmen forget that, as on the stage, there can be eloquent pauses as well as impassioned declamation. The hot metal of enthusiasm is of great value to its fortunate possessor in entering a business career, but it must be tempered with the oil of judgment in order to make a keen-cutting and effective weapon for its owner.

"Some years ago a young clerk brought in from the street a phlegmatic German jobber to look over his sample lines. The boss knew him and would ordinarily have taken a hand in the game, but, never having been able to do much with him, thought he would keep out and await developments. The enthusiastic salesman handed Mr. German a boot and gave him a full description at length of all its good qualities. As Mr. German laid it down another was handed him, and a third and fourth, with similar long and gorgeous eulogies. Finally, after saying little or nothing, Mr. German took his leave, and the manufacturer said as he passed him, 'Well, I hope you left a good sample order, Mr. German.' To which he replied, 'Thunder! I didn't get no chance.'"

The salesman of electrical energy must be able to hold his customer for many months ere he becomes a source of profit to the company. The meter is a well-trained monitor. The salesman worthy of the name will follow the Golden Rule.

The average prospect knows nothing of gas or electricity. The electric company must show to the public that it has the best. Only through cleverly written advertisements and personal solicitation can this be done, and in no part of the country is this work so necessary as in the Eastern States.

INTERIOR WIRING AND ILLUMINATION

Central-Station Illuminating Engineering Department at Denver.

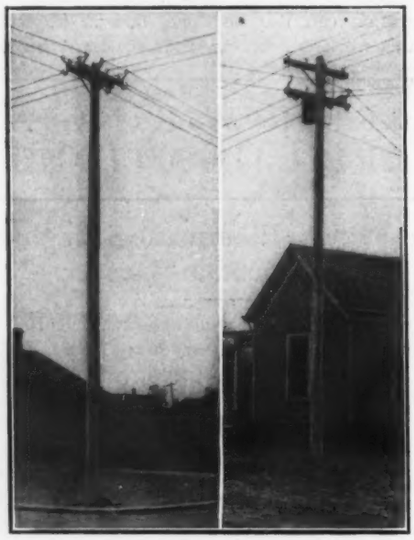
Mr. C. N. Stannard, secretary and contract agent of the Denver Gas & Electric Company, is very much pleased with the results accomplished by the illuminating department of the Denver Gas & Electric Company, which has been doing some very active work the past six months in connection with the introduction of the tungsten lamp and the increase of standards of illumination. The illuminating engineering work of this company dates back to the fall of 1905, when Mr. J. R. Cravath, of Chicago, was retained as consulting illuminating engineer for a period of six months to direct correspondence in a course of study of illuminating engineering for a club of six men of the new-business department of that company. For some time the company had no regular illuminating engineering department under that name, but illuminating engineering problems were usually referred to the members of this club. The final outgrowth of this, however, was a regular illuminating engineering department, which is now under the direction of Mr. C. F. Oehlmann.

Mr. Stannard says that the work of this department has been especially valuable in driving out gasoline competition. Strange to say, even in a city so thoroughly impregnated with electric lighting as Denver, there are, nevertheless, a number of gasoline lighting plants. The illuminating engineering department goes to the users of such plants with carefully prepared plans for an installation of tungsten lamps. The department even goes to the length of having a sketch prepared of the store showing how it will look with the new fixtures installed. The result of this in many cases has been to win the customer over to electric lighting. The work which the illuminating engineering department puts on such a job carries weight with the customer, as he feels that it is not the mere haphazard, off-hand assurance of an electric lighting solicitor, and that the results will be satisfactory. This, together with the fact that the illuminating engineering department can point to a number of successful and very satisfactory examples of work it has designed, carries the day.

Branch Lines Without Buckarms.

The accompanying Figs. 1 and 2 illustrate some very neat line construction recently done by the Mount Carmel Gas & Electric Company, Mount Carmel, Ill., of which Mr. A. R. Manley is manager. In this construction the plan extensively used by the Union Electric Light & Power Company, of St. Louis, has been adopted. Instead of placing a buckarm at right angles to the main line crossarms, as is the most common practice, the branch lines are taken off from the main line

by means of malleable cast-iron brackets. This construction can be used both for taking off branches from a main line and for running service wires to consumers. On the whole, it is claimed by companies using this construction that it is cheaper than buckarm construction, and it is certainly neater in appearance. It does away with the loose connecting loops of wire which must be used with buckarms. The branches are carried parallel with the crossarm rigidly supported by insulators, making a very substantial construction not likely to get misplaced. It is also said to be easier for linemen to work on a line with this construction than where a buckarm is used. The plan would not be suitable for locations where more than



BRANCH LINES WITH AND WITHOUT BUCKARMS.

four branch wires are to be taken off from a single crossarm, but where the possible number of such branch wires is four or less, as in the case of service wires and in many outlying parts of a primary distributing system, the plan is well adapted. In the pole seen in Fig. 1, four wooden pins are used on each crossarm. The branch pins are all double malleable cast brackets bolted through from one crossarm to the other with long bolts. These double pins carry the branch line wires rigidly over and under the main line wires at a safe distance.

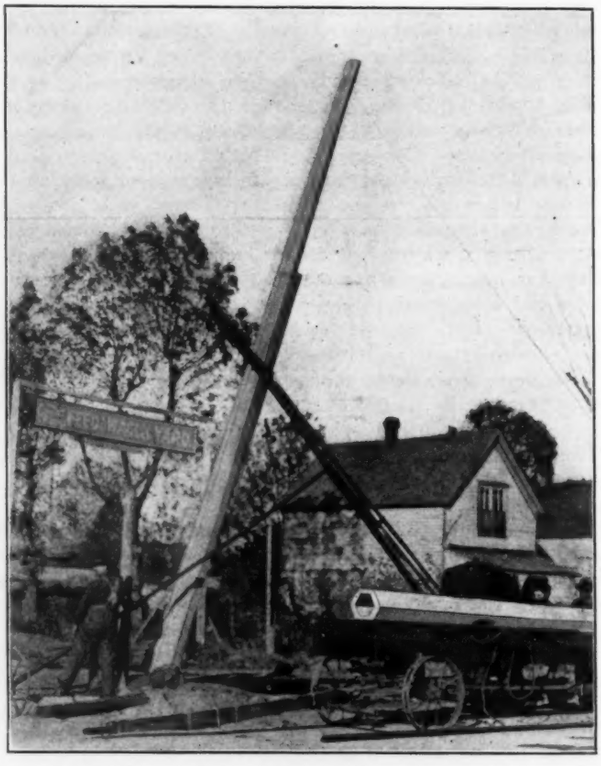
Concrete Poles.

As noted in the account in these columns of the recent meeting of the Oklahoma Electric Light, Railway & Gas Association, a paper on the construction of concrete poles was presented by Mr. J. M. Brown, superintendent of the Oklahoma Gas & Electric Company. An abstract of this paper appears below:

The poles are made hexagonal in shape and hollow in the center. A 35-pole is 7 in. across the corners at the top and 16 in. across at the butt. The forms are arranged so that by adding sections 5 ft. long to either end, poles of any length can be molded. The forms are made of heavy timber to avoid warping and are built in two halves which are clamped together and accurately lined up to insure the pole being straight. High-carbon-steel, 12¼-in. deformed-section reinforcing rods are then put in place symmetrically about the central axis. At the top of the pole the rods are secured by passing them about 2 in. through holes in a steel plate, bending over the ends and then bolting down a second plate on the bent-over ends with four small bolts. The rods are then stretched and anchored in the butt as follows: The ends of the rods project about 6 in. through holes in a steel plate fastened in the form. Pieces of ½-in. steel rod 10 in. long with an eye formed in one end and threads on the other end are used for stretching. The ends of the reinforcing rods are bent over and hooked into the eyes of the stretchers and short pieces of pipe are passed over the stretchers butting against the steel plate. A nut and washer bearing on the outer end of the piece of pipe is screwed down on the threaded end of the stretcher, giving any desired tension to the rods. The form is then ready for placing the core, which is made in two sections, telescoping with each other. The core is wrapped with one thickness of building paper and is hung in the center of the mold by suspension wires placed at intervals along the length of the form.

The concrete used consists of a mixture of one part cement, two parts sand and three parts chats or zinc tailings, which can be obtained in large quantities from the zinc mines of southwestern Missouri. With cement costing $1.50 per barrel, sand at $2 per cubic yard, chats at $2 per cubic yard and labor at $2 per day of eight hours, the cost of manufacturing a 35-ft. pole 7 in. across at the top averages $10. Three men can make three poles per day. Poles have been molded, hauled 3½ miles and set in five days' time, but this requires very careful handling and a longer time should be allowed for the concrete to set thoroughly. A 35-ft. pole molded, hauled to place and set, with steel cross-arms and pins mounted ready for stringing wires, costs $18.

The advantages for concrete poles are numerous. They are more rigid than wooden poles and wires do not swing as much as when mounted on wooden poles. The maintenance cost and depreciation are practically negligible. They resist lightning discharges and accidental grounds, can be erected with no more trouble than wooden or steel poles and can be climbed for



PLACING A CONCRETE POLE IN POSITION.

inspection or repairs as easily as a steel pole. Being hollow, wires can be run down inside, where they are protected from the weather and mechanical injury. The accompanying illustration shows a pole on a track and another in process of erection.

New Telephone Patent.

CALL-A-PHONE.

It frequently becomes necessary, especially in public places, such as hotel lobbies, etc., to call out the name of some person

sought. This is usually done by call boys, but Messrs. A. G. Kaufman and L. J. Lippmann, of New York City, have invented a telephone device for this purpose. They propose to establish loud-speaking telephones here and there about the premises, these to be wired to a transmitting station through a special switch. This special switch is so devised that the circuit of any one loud-speaker may be connected with the transmitter, or so that, by a single motion, all may be connected. For general calling all will be connected and will, therefore, announce simultaneously throughout the room whatever is spoken in the transmitter. For transmission to an individual locality, of course, one of the individual switches only will be used. Another use suggested for this device is for announcing to all rooms of a hotel general information for the guests. This will be especially applicable in case of fire. This patent is assigned to the American Call-a-phone Company, of New York.

LETTERS TO THE EDITORS.

Illumination Calculations.

To the Editors of Electrical World:

SIRS:—I find that several errors have crept into the article on "Elementary Illumination Calculations" which appeared in the issue dated June 3.

On page 1394, in fourth paragraph from the top, read "light source and accessories, which may be under consideration." In the second following paragraph read "Polar paper, devised by Mr. Norman Macbeth" instead of ". . . by Mr. A. A. Wohlauer . . . who devised the "Flux-o-light paper," not the "polar paper" mentioned.

On page 1395 the second paragraph should read, "the heights and distances are given for 6 ft. to 9 ft. height, and from a point directly under the unit to 24 ft. distance." In the following paragraph, insert the word "the" before "15 deg. and 5 deg. lines."

CHICAGO, ILL. N. WHITNEY.

To the Editors of Electrical World:

SIRS:—Allow me to endorse the remarks in your editorial commenting on the article on "Calculation of Illumination" by Mr. N. Whitney, as published in your issue of June 3. The real aim of illuminating engineering is there logically set forth, and illuminating engineers would rapidly gain ground and recognition if they heeded the practical precepts set forth.

At the same time I should like to call attention to an oversight in the article itself. The polar diagram paper which is described in the article and stated to be that of the writer, is not his "Fluxolite" paper, but seems to be the diagram paper copyrighted to Mr. Norman Macbeth.

NEW YORK. ALFRED A. WOHLAUER.

Steam Turbine Clearances.

To the Editors of Electrical World:

SIRS:—In the report in your columns of the discussion of Mr. C. H. Smoot's N. E. L. A. paper on "Low-Pressure Turbines," my remarks on low-pressure turbines are given in such condensed form that the sense of some of the statements has been entirely transverted. I am quoted as saying: "A safe clearance is feasible with reduced economy." This is incorrect, as my remarks were that "Redesigned cylinders in some of the Parsons type of turbines made it feasible to obtain perfectly safe clearances and at the same time improved economies."

PITTSBURGH, PA. E. D. DREYFUS.

DIGEST OF CURRENT ELECTRICAL LITERATURE

Abstracts of the important articles appearing in the electrical periodical press of the world

Generators, Motors and Transformers.

Artificial Cooling of Dynamo Armatures.—G. OSSANNA.—A mathematical paper on possibilities of radial cooling of dynamo armatures. The author thinks that the effectiveness of radial cooling by means of air ventilating slots is now often underestimated, but that this method can be rendered very effective if provision is made for passing a fresh air current through the ventilation ducts and if the number of the latter is not too small.—*Elek. und Masch.* (Vienna), May 23.

Constant-Torque, Direct-Current Generators.—P. GIRAULT.—A note on the self-regulating properties of series and shunt direct-current generators, operated at constant torque. A constant-torque series machine gives a practically constant current, whatever the apparent resistance of the external circuit, and independently of the portion of the magnetic characteristic curve within which the dynamo operates. When a shunt dynamo is operated in the straight-line part of its magnetic characteristic curve it does not furnish constant electric power at constant speed, independently of the current in the external circuit. But operated at constant torque its electric torque is constant between limits of angular speed which may be quite near together, independently of the current.—*L'Industrie Elec.*, May 25.

Centrifugal Force.—H. LUCKIN.—For use in electrical drawing offices, for calculating the centrifugal forces acting on the various parts of the armatures, windings, commutators, etc., the author finds the following formula most suitable:

$$F = WRN^2 \div 35{,}340$$

where F is the centrifugal force, W the weight in pounds, R the radius in inches, and N the number of revolutions per minute. If the radius R is given in feet, the formula becomes

$$F = WRN^2 \div 2941.$$

Finally a table is given which facilitates the calculation of centrifugal force.—Lond. *Electrician*, May 28.

Transformers.—H. W. TOBEY.—A second article on recent developments in electric transformers with special reference to recent designs of lamp transformers and the tungsten lamp compensator, and with a description of the transformer testing equipment of the General Electric Company.—*Gen. Elec. Rev.*, June.

Lamps and Lighting.

Metallic-Filament Lamps.—LAPORTE.—An account of tests of metallic-filament lamps in the Central Laboratory of Electricity in Paris. Nine different types of lamps for 100 to 125 volts and 220 volts were tested. The metallic filament of a 110-volt lamp can already be observed in the dark at 4 volts, and at 5 volts it becomes incandescent. With 110-volt carbon-filament lamps, incandescence can be observed not below 20 volts. The specific consumption of the tungsten lamp in commercial operation was found to be 1.3 watts per candle-power, that of the tantalum lamp 2 watts, and that of the carbon-filament lamp 3.5 watts. The following tables give the relation between change of voltage in per cent and changes of candle-power in per cent, and the relation between change of resistance in per cent and change of voltage in per cent:

Per Cent of Normal CP.	Per Cent of Normal Voltages. Tungsten.	Tantalum.	Carbon.
10	56	59	71
50	83	85	90
100	100	100	100
150	112	110	107
200	122	118	110

Per Cent of Normal Voltage.	Per Cent of Normal Resistance. Tungsten.	Tantalum.	Carbon.
10	40	48	...
50	76	82	115
100	100	100	100
120	107	105	96

The candle-power is proportional to the nth power of the voltage. For tungsten lamps $n = 3.6$ to 3.8; for tantalum lamps,

3.9 to 4.3, and for carbon-filament lamps, 5.8 to 6.5. The candle-power is the bougie-decimal. None of the metallic filaments investigated had a specific consumption as low as 1 watt per candle at normal voltage; the consumption varied between 1.25 and 1.8. A series of tests was made concerning the uniformity of lamps bought from the same factory, with respect to specific consumption and candle-power. The greatest deviations which were observed on five different types of 110-volt metallic-filament lamps were between 2.4 and 6.6 per cent with respect to candle-power and 2.4 and 5.2 per cent with respect to specific watt consumption. The ratio of the mean spherical candle-power to the horizontal candle-power is between 0.74 and 0.8 for metallic-filament lamps; it is smallest for tantalum lamps.—*Bull. Soc. Int. Elec.* (Paris), February; abstracted in *Elek. und Masch.* (Vienna), May 23.

Metallic Filaments from Colloids.—A note on a recent British patent of H. Kuzel (25,443, 1908; May 20, 1909). In the formation of filaments from colloidal mixtures, it is necessary to raise the threads to a white heat to destroy the colloidal formation and reduce them to pure metal filaments. It has been usual to perform this operation in an atmosphere of an inert gas at, or slightly below, atmospheric pressure, but the filaments produced in this way frequently contain cavities which, besides causing an irregular resistance, make the filaments liable to break. According to this invention, the heating is carried out in a stream of gas containing 20 per cent of hydrogen and 80 per cent of nitrogen at a pressure of about 30 mm. An absolute vacuum would be better, but is not practicable; the gases are kept flowing so as to prevent a harmful rise of pressure due to the gases given off by the filaments. Filaments formed in this manner are rarely porous, as the gases escape before cavities can be formed. The filaments are brought up gradually to a white heat, and are subjected to tension during the heating by hanging weights or other suitable means. The gases given off increase the pressure somewhat, but it should not rise above 150 mm.—Lond. *Elec. Eng'ing*, May 27.

Illumination Cost Factors.—M. Harris.—An article in which the author first discusses the cost of the current consumed in electric illumination as depending on efficiency and conditions of illumination. He compares five different systems of an assumed case in which it is desired to light an area of 100 ft. x 100 ft., used for commercial purposes and wired one outlet per bay, the intensity on the plane of reference to be four candle-feet. The author's conclusion is that the wattage required to illuminate the space considered would be as follows:

	Watts.
1—Nernst lamps with light opal ball	108,000
2—Tungsten lamps with clear prismatic reflectors	108,000
3—Tungsten lamps with enameled prismatic reflectors	124,000
4—Tungsten lamps "I" comfort system	144,000
5—Direct-current enclosed arc lamps	148,500

Although in cases 2, 3 and 4 lamps having a specific consumption of 1.62 watts per mean spherical candle were employed, on account of their treatment in cases 3 and 4, the consumption of power required was greater than in case 1, where Nernst lamps were considered having a consumption of 2.25 watts per mean spherical candle. For all practical purposes, therefore, the author concludes that the efficiency of the 220-volt Nernst lamps for interior illumination may be placed as being equal to that of the tungsten system consisting of a combination of clear prismatic glassware and tungsten lamps operating at 1.25 watts per mean horizontal candle-power. The cost of renewals or maintenance is a very important factor when considering the relative cost of operation of the high-efficiency systems, whose illumination efficiencies are approximately equal. It is the author's belief that the proper method of computing renewal costs is on the basis of cost per kw-hour. In the cost of maintenance the labor item for cleaning the lamps and reflectors, etc., is an important one. First cost or investment should be considered purely from a standpoint of earning power.—*Elec. Jour.*, June.

Illumination of Streets.—C. E. Stephens.—An article giving some general considerations on street lighting, especially by different kinds of arc lamps, giving curves of the light distribution. Tungsten incandescent lamps can be used very successfully in cases where the results obtained are to be at a minimum expense, and where the conditions will not permit of high candle-power units of the arc type.—*Elec. Jour.*, June.

Illumination.—T. W. Rolph.—A lecture giving a general outline of the fundamental principles of the theory and practice of illumination.—*Journal Franklin Inst.*, May.

Power.

Self-Starting Synchronous Motors.—J. Bache-Wiig.—The use of synchronous motors for service previously performed almost exclusively by induction motors has largely increased recently owing to the beneficial effect of synchronous motors on systems having low power-factors. The author discusses at some length the starting action of self-starting synchronous motors and shows that it approximates that of induction motors with fairly low resistance, cage-wound rotors. It may be taken as a general rule, therefore, that self-starting synchronous motors can be applied where it is possible to apply cage-wound induction motors with small slip, with the additional limitations in the case of the synchronous motor imposed by the necessity of overcoming the "slip," and pulling into synchronism. Where a phase-wound induction motor with external secondary resistance must be used because a cage-wound induction would not be satisfactory, then for the same reason, a synchronous motor of the self-starting type would not be satisfactory and should not be used.—*Elec. Jour.*, June.

Cost of Motor, Power and Product.—C. F. Scott.—An article pointing out that while first cost of the motor and the cost of the power which drives it are elements in the total cost of production, yet the cost of the motor and of the power are often in themselves of so little importance that to economize in them may be wasteful and foolish. In general the problem is not how to use as little power as possible, but how to apply as much power as can be used effectively. It is the cost of labor and the quantity of output which can be secured from a given factory equipment which are usually the large factors in the cost. When the annual fixed charge for an ordinary motor is $5 per year for a production amounting to $500 per year, it would be profitable to invest several times as much if an equipment can be secured which will enable the total cost of the production to be reduced by even a relatively small per cent. Efficiency in power consumption of a motor, important in itself, is of trivial consequence compared with effectiveness in performance.—*Elec. Jour.*, June.

Water-Power Plant in Switzerland.—F. Loppe.—An illustrated description of the water-power station at Wangen, utilizing the fall of the Aar River, and supplying energy to the adjoining districts and also to the city of Basel and to the power plant at Rheinfelden. There are seven Francis turbines, each driving a 1500-hp, 11,000-volt, three-phase alternator. At the end of 1907 the complete network had a length of 333 km (200 miles), partly at 25,000 volts, partly at 10,000 volts, and partly at 6400 volts or less; besides 200 km (120 miles) of low-tension lines. The total rating of motors connected to the plant at that time was 3450 kw and that of lamps 3800 kw.—*L'Industrie Elec.*, May 25.

Mexico.—A former article described general conditions of electric railway operation in Mexico City. In this issue the track, overhead line, power generating and transmission system, shops and car houses of the tramway system are illustrated and described, together with the principal features of operation. The tramway company in Mexico manufactures nearly all of the material and supplies, and its shops are completely equipped with modern machinery. Current is brought from the water-power station at 60,000 volts to the main substation in the city and from there distributed to four substations, all receiving the current at 20,000 volts and distributing it at 600 volts. Two of these substations contain two 500-kw motor-generator sets each and the other two contain each two 1000-kw sets with the necessary transformers and accessories. In addition the company has built a portable substation of 500-kw capacity.—*Elec. Rail. Jour.*, June 5.

Water-Power Plant.—K. Thien.—An illustrated description of the electricity works of Karlstadt in Austria-Hungary. A

waterfall with a 9-m head is utilized. There are two 900-hp turbines driving 780-kva, 5000-volt alternators, the frequency being 50. For transmission the voltage is raised to 20,000.—*Elek. und Masch.* (Vienna), May 16.

Electric Hoisting in Mines.—C. V. ALLEN.—An illustrated article on the operation of mine hoists by electric motors, with special reference to the installation of the El Oro Mining & Railway Company, Ltd. Power for this camp is supplied by the Mexican Light & Power Company. It is located 171 miles from the source of power, there being a total of about 4000 hp in motors installed for hoisting service alone. Of these hoisting outfits, there are four motor-generator flywheel sets in use, with a fifth under construction. The largest of these five flywheel sets consists of a 350-hp, 50-cycle, three-phase, 3000-volt induction motor, and a 320-kw, direct-current, 250-volt, interpole generator, with a 40,000-lb. flywheel, 9 ft. in diameter, mounted on a common shaft between the two machines; the no-load speed of this set being 480 r.p.m. The operation is described in detail and various curves showing the conditions of operation are given. The cost of the hoisting of this outfit has been very satisfactory, amounting to but seven cents, Mexican money, per 1000 foot-ton; the former cost of hoisting by steam having been many times the present cost by electric power.—*Elec. Jour.*, June.

Tilting Furnaces.—I. DEUTSCH.—An illustrated article on the automatic control of motors operating four 225-ton open-hearth tilting furnaces at the works of the Jones & Laughlin Steel Company, Pittsburgh, Pa. Four 30-hp, 220-volt motors are used

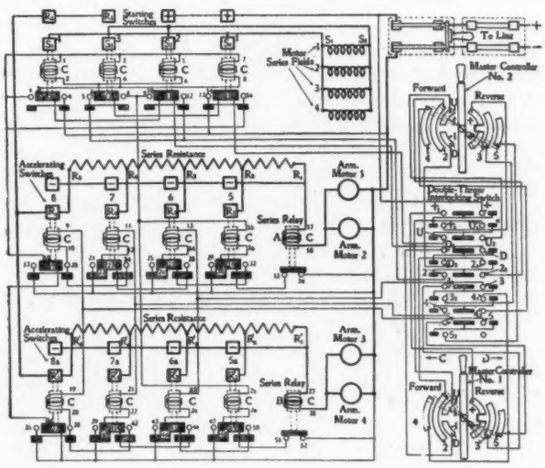


FIG. 1.—DIAGRAM OF CONNECTIONS.

with each furnace and are operated and controlled by an automatic magnetic switch controller, provided with two master switches and an interlocking switch. Each master switch is so connected that when its handle is turned in one direction the furnace is tilted, and by reversing the furnace may be restored to the normal level position. One of the master switches is located on the front side of the furnace so that the operator will be in a position to watch the pouring of the cast. The other master switch is at the rear where the operator can watch the tilting of the furnace to run off slag and facilitate charging with hot metal. The interlocking switch is so arranged that only one master switch is in circuit at one time. This makes it impossible for two operators, located at the respective master switches on the opposite sides of the furnace and out of view of each other, to operate both switches at the same time. Referring to the diagram of connections of the outfit, Fig. 1, it may be seen that the armatures of motors 1 and 2 are connected in parallel and included in the circuit with a series limit relay, *A*, and a starting resistance, R_5R_1. The armatures of motors 3 and 4 are similarly interconnected with a relay *B*, and a resistance $R_5' - R_1'$. The fields of all four motors are connected in parallel. When it is desired to tilt the furnace forward at minimum speed, the handle of the master controller No. 1, for example, is thrown to the forward contact $U - 1$. In the diagram of the interlocking switch is shown a "developed" drum controller, all shaded rectangular contacts being mounted on the drum and moving with it. With it set in position *C*, magnet switches 2 and 4 will close and current will pass from the positive line to contact S_3 on switch 2, through the four fields to S_1, on switch 4, then through the starting resistances, limit relays, and motor armatures to the negative line. The motors will now run at lowest speed forward. To obtain moderate acceleration, the handle of the master switch No. 1 is thrown into contact 2, when switches 5 and 5_a will close and cut out sections R_2R_1 and $R_2'R_1'$ of the starting resistance. This operation may be continued, if desired, until all of the starting resistance is cut out or, as is customary, the master switch handle may be thrown from the off position to full-on (contact 5), and the motors will automatically accelerate to full speed as follows: Line switches 2 and 4 close first, as already mentioned, and the motors start. The starting current is sufficient to lift the relays *A* and *B* and open circuits 33-34 and 51-52. As the motors accelerate, the current decreases, until the relays drop and again bridge the contacts 33-34 and 51-52. Switches 5 and 5_a then close and cut out sections R_3R_1 and $R_3'R_1'$ of the starting resistance, which causes a current rise sufficient to again lift the relays. When the current reaches the normal value, the relay drops and switches 6 and 6_a close, thereby short-circuiting sections R_4R_1 and $R_4'R_1'$ of the starting resistance, lifting the relays and accelerating the motors to still higher speed. When the current peak caused by the closing of these switches has passed, the relays drop and the cycle is automatically continued until switches 8 and 8_a have been closed and the motors are connected across the line and running at normal speed. The motors are reversed by throwing the master switch handle to the reverse position, when switches 1 and 3 will close, instead of 2 and 4, which remain open, and the current passes from the positive line to contact S_1 on switch 1; through the four fields in the reverse direction to S_2 on switch 3; then through the resistance relays and armatures to the negative line. The relays are so wound that they will respond to small variations from normal current, and are accurately adjusted for uniform load. If the motors do not possess the same inherent accelerating characteristics—i.e., if one set has a tendency to run ahead of the second and take a greater current from the line—the relay governing the first set will lift and prevent further acceleration until the second set has had a chance to catch up.—*Elec. Jour.*, June.

Variation of Angular Velocity of Flywheels.—A. R. HORNE.—An illustrated description of a method of determining the variation in angular velocity and the angular lag and lead of an engine flywheel from the diagram of crank effort by means of a planimeter.—Lond. *Eng'ing*, May 28.

Turbine Regulation.—A. RENARD.—A mathematical note on the principles of the regulation adjustment of turbines.—*La Houille Blanche*, February.

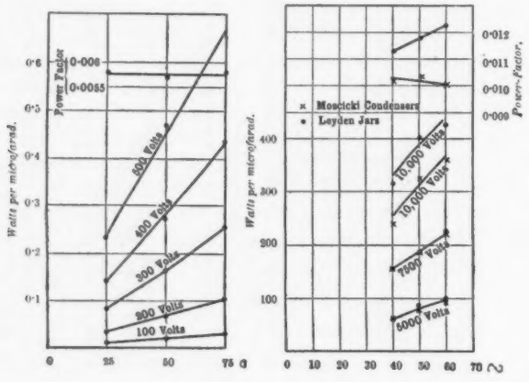
Traction.

St. Paul and Minneapolis.—The Twin City Rapid Transit Company, operating the city and suburban system of St. Paul and Minneapolis, obtains electrical energy from three generating stations, the old hydraulic station at St. Anthony Falls on the Mississippi River, a large steam-power station, and a new hydraulic station on Hennepin Island which utilizes the overflow from St. Anthony Falls. This article describes the new station which contains four generating units, each of 2250 kw capacity and includes a great many statistical diagrams showing the power output of all three stations, together with other data on their combined operation.—*Elec. Rail. Jour.*, June 5.

Overhead Construction for Railways.—P. DAWSON.—The continuation of his long illustrated serial on electric traction on railways. In the present installment, the author describes various details of catenary construction and gives some rules to be considered in the design of overhead construction for railway work.—Lond. *Electrician*, May 28.

Application of Condensers.—W. M. MORDEY.—A paper read before the (Brit.) Inst. Elec. Engineers. The general question

is discussed whether condensers can be used commercially instead of over-excited synchronous motors for the improvement of power factors in distribution networks. Tests are given of Mansbridge low-tension paper condensers, and of Moscicki high-tension condensers. The author has determined the losses in both types of condensers, the results being given in Figs. 2 and 3, the former giving the results of tests of low-voltage Mansbridge paper condensers, and the latter of high-voltage glass condensers, both of the Moscicki type and of the Leyden jar type. These diagrams give the loss in watts per microfarad at various voltages and frequencies, and the power factor at various frequencies. The capacity, as shown by the proportionality of current to pressure, and to frequency, was almost constant. As to the Moscicki condensers and the Leyden jar type it will be seen that at 5000 volts and at 7500 volts the loss in watts per microfarad in the Moscicki condenser and in the Leyden jars is the same, but at 10,000 volts there is a marked difference. In comparing low-voltage and high-voltage condensers it must be remembered that the power factor, and not the watts per microfarad, is the proper basis, seeing that the loss (as well as the kilovolt amperes per microfarad) appears to rise as the square of the pressure in any given condenser. The proper basis of comparison is the loss in a paper condenser, made up in sections for high-pressure use in one case, against the loss in the special high-voltage glass condenser of the same capacity. From the results shown, a 10,000-volt Mansbridge condenser would lose about 190 watts per microfarad at 50 periods; and the Moscicki 10,000-volt condenser would lose



FIGS. 2 AND 3.—CONDENSER TESTS.

about 320 watts per microfarad, the loss in the latter case being less accurately measured than in the former. It is satisfactory to find that the losses are so small. They are respectively about 0.6 per cent and about 1 per cent of the kilovolt amperes dealt with. These losses are of the same order as the magnetizing losses in transformers of good design. With such small losses as these, no difficulty should be experienced in preventing objectionable heating. Condensers lend themselves very well to arrangements giving large cooling surface. In the Moscicki type, the tubular form ensures this. The Mansbridge type can be subdivided to give any desired cooling surface. The author finally attempts to compare the use of condensers with that of over-excited synchronous motors for the pupose of improving the power factor. The comparative figures for the compensation of a circuit requiring 1000 kw at 10,000 volts, 50 periods, with a power factor of 0.8, are as follows;

	Synchronous Motor.	Condenser.
Capital cost	$5,000	$3,600
Annual cost of energy wasted	685	171

The author thinks that condensers used for such purposes might prove quite useful. He finally describes some experiments on the use of condensers for preventing or stopping the formation of arcs under certain conditions. In investigating the action in a surface-contact tramway system recently, the author found that trouble was experienced due to the formation of persistent arcs at the underground contacts. When the road was wet and dirty a small leakage current passed from the live contact stud under the car over the surface of the road to the rails. When the car has passed and the underground contact-piece had separated its proper distance from the live conductor, this leakage current was sufficient to maintain an arc across the air-space of the contact-maker, thus keeping the stud alive so long as the arc persisted. It was found that with a terminal voltage of about 560 volts, the voltage between the studs and the rail was usually about 400 to 440 volts, and the voltage across the arc about 120 to 160 volts. Sometimes, arcs would persist for a few seconds with not more than 0.6 amp, and they would often persist when the leakage current was over 1 amp—this latter condition, it will be seen, corresponds to a resistance of the leakage path from the stud to the rail of a maximum of 440 ohms. A suitable condenser placed across the gap prevents any arc being formed, however small the gap—for example, it was not possible to maintain an arc across a gap of even 1/64 in. If the arc is formed and it is then shunted by a suitable condenser, it will at once go out. It was found quite practicable to extinguish the arcs by shunting them by a condenser carried on the car, one terminal being connected to the collector, or skate, the other to a small wire brush hanging down under the rear platform of the car, and making successive contacts with the studs.—Lond. *Electrician*, May 28.

Day Loads for Central Stations.—S. A. Fletcher.—A brief discussion of various profitable day loads for central stations. The author first speaks of the domestic use of electricity, electric flatirons, sewing-machine motors, electric toasters, luminous radiators, coffee percolators, washing-machine motors, vacuum cleaning apparatus, etc. With respect to selling electric power to manufacturers, he discusses pumping of water, electrically driven blowers for blacksmiths, cash carriers in stores, electrically operated refrigerating machines, ventilating and exhaust fans, electric driving in machine and repair shops, in printing plants, and in bookbinders' shops and wood workers' establishments, etc.—*Elec. Jour.*, June.

Protection of Networks.—Grosselin.—A long report made to the Marseilles Congress on the different methods in use for protection of transmission lines, against sudden dangerously high voltages.—*La Houille Blanche*, April.

Line Construction.—Le Roy.—A paper presented to the Congress at Marseilles on the construction of transmission lines. The author thinks that for some time to come wooden poles will continue to be used exclusively in small distribution systems in cities and for transmission lines of moderate size (1200 to 1500 kw). Metallic poles (galvanized steel) appear to be now in Europe generally employed in large transmission lines. A few notes are finally given on reinforced concrete poles, but it is thought that they have not been long enough in use to form a conclusive opinion about them. Some comparative figures are given on the cost of construction.—*La Houille Blanche*, March.

The Earth as Return Circuit.—A long report by E. Brynlinsky to the Congress at Marseilles on the use of the earth as part of a commercial transmission circuit. Another paper by Barbillion gives an account of experiments made in 1906 and 1907 on the same subject. Both papers, which have already been briefly noticed in the Digest, are here printed in full.—*La Houille Blanche*, March.

Aluminum Conductors.—Dusaugey.—A paper read before the Marseilles Congress on the use of aluminum as an electric conductor. The author gives various data and formulas useful for aluminum line calculations.—*La Houille Blanche*, April.

Underground Cables.—De Marchana.—A paper presented to the Marseilles Congress on underground cables, their construction, method of laying, and testing.—*La Houille Blanche*, May.

Units, Measurements and Instruments.

Limit Switch.—H. Andre.—An illustrated description of an automatic switch for use in such installations in which the contract made with the customers does not permit the latter to take more than a certain maximum amount of power from the line, with the penalty of being cut off. Of course, the limit switch used for this purpose should have a time factor permit-

ting brief overloads; it should also indicate by some alarm device that the danger limit has been passed. And after the switch has acted and the consumer goes back to the permitted load, connection should be easily re-established. The instrument of the author is shown diagramatically in Fig. 4. A small induction motor consists of two primary windings 7 producing a rotary field, and the disk 6 which is thereby caused to rotate. While rotating it raises, by means of the thread 9, the vessel 1 containing water. This vessel has a hole 2 in the bottom and is itself suspended in another vessel 5, also filled with water.

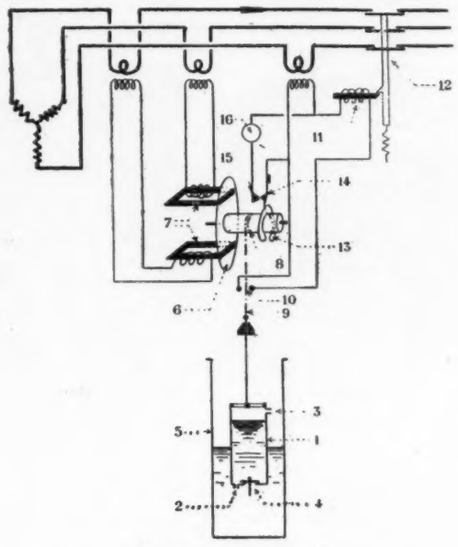


FIG. 4.—LIMIT SWITCH.

The electromagnetic torque exerted on the disk 6 raises the inner vessel 1 until a position of equilibrium is reached. But this equilibrium is disturbed again by water flowing out of the hole 2 in the bottom into the outer vessel. The vessel 1 is therefore again raised and this goes on continually, so that the inner vessel 1 slowly rises upward until it is entirely out of the water. After that it will rise more quickly (if the torque on disk 6 continues). The total time of this rise of the vessel 1 will be the shorter, the greater the torque of the disk 6. When the vessel 1 reaches its highest point, the contact piece 9 at 10

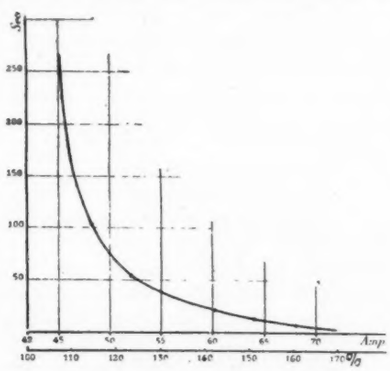


FIG. 5.—TEST CURVES.

closes a circuit which contains the electromagnet 11 which acts on the circuit-breaker 12. The valve 4 at the bottom of the vessel 1 permits the latter to drop down again quickly if the current diminishes before the vessel 1 has reached its highest point. The spiral 13 during the rise of the vessel 1 produces at each revolution of the axle a contact between 14 and 15, whereby the alarm bell 16 is operated. On the other hand, while the vessel 1 drops down, the spring does not make contact and the bell is not set in operation. According to the weight of the vessel 1, its volume, and the size of the hole 2, it is possible to adjust the time factor of the instrument. Fig. 5 gives test curves showing the time within which the instrument acted for a certain overload. The ordinates represent the time in seconds within which the circuit was broken. The upper scale of the abscissas gives the amperes, the lower scale the overload in per cent of the load to which the instrument is adjusted. The instrument was set to a maximum permissible current of 42 amp. It will be seen that at 45 amp (7 per cent overload) the current was broken after 250 seconds; at 55 amp (31 per cent overload) it was broken after 40 seconds, and at 72 amp (71 per cent overload) it was broken within four seconds. When the circuit-breaker 12 has operated the current acting on the disk 6 ceases and the vessel 1 falls down again. The circuit containing the electromagnet which acts on the interrupter is thereby opened, and the interrupter may therefore be reset and the circuit closed again.—*La Houille Blanche*, February.

Testing Bureau.—BOYER-GUILLON.—A long and fully illustrated description of the department for machine testing of the testing laboratory of the Conservatoire National des Arts et Metiers in Paris. Various apparatus for testing of steam machinery are first described, followed by full descriptions of hydraulic tests (equipment and apparatus, tests of centrifugal pumps and turbines, and of water meters of different types).—*La Houille Blanche*, January, March, April and May.

Telegraphy, Telephony and Signals.

Telegraph Cables.—An illustrated description of two submarine cables recently laid in Australia from Victoria to Tasmania. The conductor of the cable is formed of strands of 7 in. x 0.032 in. high-conductivity copper wires, weighing 130 lb. per nautical mile. The insulation consists of three layers of best gutta percha, also weighing 130 lb. per nautical mile. The layers of gutta percha were applied without intervening coatings of Chatterton's compound. The conductor resistance of the cable is 11.65 ohms and the inductive capacity 0.37 microfarad per nautical mile at 75 deg. Fahr. The insulation resistance of the completed cable is 2300 megohms per nautical mile at 75 deg. Fahr.—Lond. *Elec. Eng'ing*, May 27.

Miscellaneous.

British Patent Law.—The appeal by the British Westinghouse Company and Körting & Mathiesen against the decision of the Comptroller-General of Patents to revoke the Bremer and Högner flame-arc-lamp patents, respectively, under section 27 of the new British patent act has been successful. The proceedings were suspended in March in order that fresh evidence could be put in by the Westinghouse company, the owners of the Bremer patent. This evidence is to the effect that considerable trouble and expense have been gone to in the efforts to establish the manufacture of the lamps in this country. On the other hand, Mr. Braulik, the applicant for revocation, asserted that he intended to manufacture in this country; that he had applied for a license under the Bremer patent, but could only have obtained it by paying a higher royalty than Körting & Mathiesen. It was urged that there was no true competition between the Westinghouse company and the Union Electric Company, as by the agreement the former company could not undersell the latter. In giving his decision against the revocation of patents, Justice Parker upheld the contention of the Westinghouse company that satisfactory reasons had existed for their not having been able to manufacture the lamps to an adequate extent in this country. He ruled that each side should pay its own costs.—Lon. *Elec. Eng'ing*, May 27.

Electrical Industry in Switzerland.—M. GUBLER.—Some statistical notes on electrical imports and exports to and from Switzerland. The importations to Switzerland of electric generators, machinery, appliances, etc., were 13,000 kg ($1,007,500) against 12,144 kg ($963,750) in 1907. The exportations of electrical machinery, etc. (principally dynamos), from Switzerland to other countries were 85,854 kg ($4,874,440) against 78,440 kg ($4,290,000) in 1907. The importations of copper, wires and cables into Switzerland in 1908 were 93,160 kg ($4,780,000) against 78,683 kg ($3,955,000) in 1907.—*Schweitz. Elek. Zeit.*, April 17; abstracted in *l'Industrie Elec.*, May 25.

NEW APPARATUS AND APPLIANCES

Marshall Chain-Pull Socket.

The popularity of lamp sockets operated with a chain pull has so stimulated designers and inventors that improvement in this line has been constant, and one of the latest is shown in the accompanying engraving. There has been a demand for a socket uniform in size with standard sockets and with means for adjusting the chain pull in relation to the fixture. These requirements are claimed to be completely realized in the present socket, known as the "Smooth Idea" socket. This consists of the standard snap-fastened cap and shell used in the standard Marshall socket. There are three variations, however, in the cap, one being provided with an insulating bushing for cord work, another with a standard form of set-screw cap, while the third is especially designed for fixture work and has a swiveling nut which permits the adjustment of the chain pull in any position. The cap is put on with a wrench and can be secured in place in a fraction of the time required to put on ordinary sockets.

The chain pull, which is attached to the body of the socket, can be easily removed for refinishing by unscrewing with the fingers. The chain can be detached and inserted in a few seconds, a pair of forceps being enclosed in each box of sockets

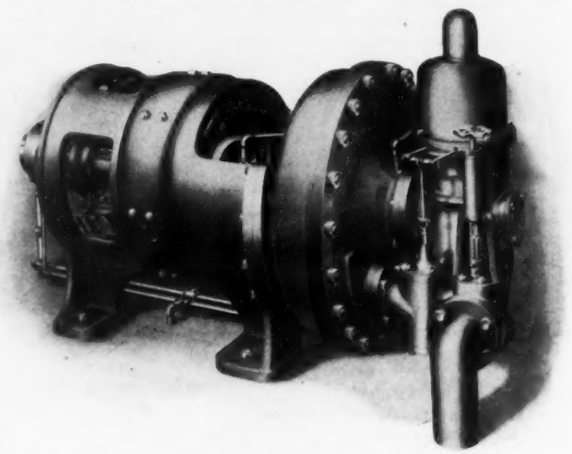
CHAIN-PULL SOCKET.

for doing this. There are no crevices in the cap and shell fastening to catch acid or other objectionable material in refinishing the shells. The shell and cap are lined with a one-piece "Elastoid" fiber lining. The socket, which is shipped out properly adjusted, can be wired without removing the chain guide. It is manufactured by the Marshall Electric Company, of Hyde Park, Mass.

Train-Lighting Turbo-Generator Set.

The new Westinghouse train-lighting turbo-generator set shown in the accompanying illustration has been designed to meet the exacting requirements of a small steam-driven generating outfit for train-lighting, excitation, or other small-power, direct-current service, where a compactness and minimum weight are essential. The generator output is 25 kw at 125 volts, and the machine is designed to run at 3600 r.p.m. The turbine element is of the impulse class, but of novel construction. A single wheel is employed, involving a re-entrant path for the steam, which is expanded practically to exhaust pressure in the nozzles.

The generator is compound wound, insuring close voltage regulation, while its 4-pole field structure, with auxiliary commutating poles, makes possible diminished weight and length of commutator, and thus, shortened over-all dimensions. The compact structural connection between the turbine case and generator frame also contributes to shortening the over-all



TRAIN-LIGHTING TURBO-GENERATOR SET.

shaft length, adapting the outfit admirably for installing, in the restricted space of the baggage car, where, in train-lighting service, it is intended to be placed. On account of the possible oscillation and vibration of the car, oil rings are not relied upon for lubrication of the two bearings, an oil pump, attached to the turbine, being provided to insure circulation of oil in ample quantity while the outfit is in operation. Provision is also made for accurately balancing the rotating part, avoiding any possible vibration that might occur.

A specially designed fly-ball governor geared directly to the turbine controls a nickel-bronze balanced puppet valve. The governor mechanism is unique in design, insuring excellent regulation, stability and certainty of operation. With the turbine is furnished a combined automatic and hand throttle valve, the automatic feature of which is operated by a weight held by a spring against centrifugal force, and entirely independent of the main governor. The apparatus is exceedingly simple and hence certain in its operation. The device may be regulated to come in at any predetermined speed.

The new Westinghouse train-lighting turbo-generator set, embodying superior advantages of lightness, compactness and efficiency, as above noted, is being exhibited for the first time in the Westinghouse space at the conventions of the Master Mechanics' and Master Car Builders' Associations, at Altantic City, June 16 to 23.

Exhibits at the Cleveland Industrial Exposition.

The Cleveland Industrial Exposition is scoring a great success, and probably will give rise to similar shows in other progressive cities. The general attendance is unexpectedly large from without the Cleveland district, and one of the features is the large number of delegations from boards of trade and chambers of commerce. Following is a list of the exhibits from the electrical and allied industries:

A large machine motor, small motors for various purposes, generators of all capacities, fan motors, small machines electrically operated and a number of other appliances were shown by the Westinghouse Electric & Manufacturing Company. Men from the city office are in charge of the display.

An interesting feature of the Lincoln Electric Company's

display is the operation of a motor under water. This is done to show the perfection of the insulation. A motor with a new idea in governors is also shown in operation, as well as long-pull solenoids and other products of the factory.

A full line of rheostats, switches, panels and switchboard appliances comprises the exhibit of the Leonard-Bundy Electric Company. In addition the company is showing some of the instruments manufactured by the Weston Electrical Instrument Company and the Wagner Electrical Manufacturing Company.

Steel shafting of various sizes, cables, wire, rail bonds, flat wire, springs, spikes, nails and staples are arranged in an attractive manner by the American Steel & Wire Company, whose booth occupies a position just at the entrance of the temporary building. All kinds of wire fences, in rolls and erected, are also to be seen. The display is complete and worth seeing by those who use any of its products.

The Forest City Steel & Iron Company is showing a sample of its structural steel work and in addition a large number of photos of structural work which it has erected.

The display of the American Ball-Bearing Company consists largely of automobile axle gearings. The only portion of it that may be called live is the ball sorting and counting machine, which attracted a great deal of interest.

A Porter switch, switch stands, guard clamp rail, square and angular crossings, rail joints and various kinds of specialty work are shown by the Cleveland Frog & Crossing Company.

The G. C. Kuhlman Car Company is showing a section of a pay-as-you-enter car, such as is now seen in operation in many cities. The rear platform, with floors and dividing rail, gives a general idea of the manner in which the car is constructed. It is cut through a few feet in front of the rear end doors, showing the construction and the arrangement of seats. Plush-covered and rattan seats are displayed on the outside.

The Chisholm & Moore Company is showing a large line of trolley hoists, high-speed chain hoists and other appliances used in shops where heavy articles are handled. The display was sufficient to give a good idea of the product of the factory. A small model of a track drilling machine is arranged on a platform, so that a close inspection may be made of it.

The Sherwin-Williams Company showed a full line of effects secured from the use of its paints and varnishes. The company makes colors, paints and varnishes for almost every conceivable purpose, but instead of filling its handsome booths with canned products, it used panels arranged on frames to show results. Street-car work was displayed in a series of panels, showing the process of finishing from the dressed wood to the varnished surface. Paints for railroad coaches and interior work were also displayed.

Multiple Starters for Large Direct-Current Motors.

For starting small motors face-plate rheostats are used extensively and give a high degree of satisfaction, but for motors of large size it is very difficult to build a satisfactory rheostat of this type which will be free from sparking under the large current handled; moreover, large motors are capable of producing far more damage when handled by a careless operator than small motors are, and it is therefore particularly advisable to have starting devices which are proof against careless and ignorant operators. To meet this situation the Westinghouse Electric & Manufacturing Company has constructed a line of multiple-switch starters for motors from 50 hp to 600 hp, which are made up of a number of single-pole, butt-joint switches mounted on a slate panel with a separate resistance. The general appearance of a double-pole starter for low-voltage circuits is given in Fig. 1. The motor is started by closing the switches, one at a time, in regular consecutive order from right to left. In the double-pole type, as shown in Fig. 1, the closing of the first switch connects one side of the motor circuit to the line, and closing the second establishes the shunt-field circuit and the armature circuit, the latter through the entire starting resistance. Each succeeding switch short-circuits a section of resistance and the last one also provides a permanent circuit for no-voltage and overload release coils.

It is impossible to close the switches except in the proper order, as they are interlocking. The switch on the extreme right, facing the board, must be closed first, and each switch when closed permits the closing of only the one next on the left and is itself locked until the first switch is opened. Thus

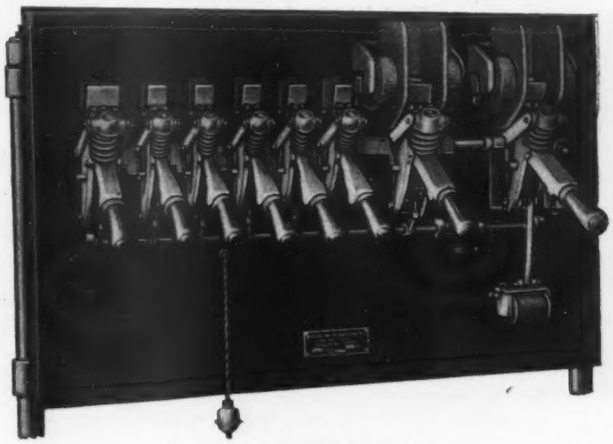


FIG. 1.—DOUBLE-POLE STARTER.

the motor cannot be started and thrown across the line in a shorter time than is required to close all of the switches one by one. To limit the current to full-load value, one minute should be allowed for starting; if started in half this time the current will be 50 per cent greater.

As an additional protection in starting the low-voltage release device which operates the first switch is not connected permanently to the line until the last switch is closed, and the first switch will remain closed only while the no-voltage release magnet is excited. If current is cut off from this coil for any reason, the switch will open and release all the others. Therefore, in order to be able to keep the switches closed while starting, an auxiliary circuit for the no-voltage release magnet is closed by pressing a push-button until the entire starting resistance is short-circuited. This insures against an operator inadvertently leaving part of the switches open.

On the double-pole starters the first two switches are single-pole circuit-breakers, but on the single-pole starters the first

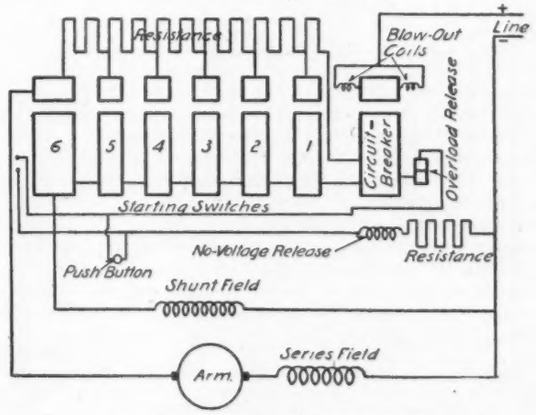


FIG. 2.—DIAGRAM OF CONNECTIONS.

switch only is a circuit-breaker. Powerful blow-out coils are provided on these breakers to prevent injurious arcing when the circuit is opened. The overload release opens the circuit of the low-voltage release magnet, and since this magnet must be excited while starting as well as while running, the motor is protected from overloads at all times. Fig. 2 shows a diagram of connections for a single-pole starter with six sections of resistance.

Industrial and Commercial News

Commercial Intelligence.

THE WEEK IN TRADE.

The condition of trade during the past week continues to show a distinct improvement. Reports from the West indicate that, in spite of very unfavorable weather, retail business has been fair. In the central markets the wholesalers and jobbers have been receiving a few orders, these, of course, being mainly for filling in purposes. Inquiries for the fall are beginning to come in, and the general sentiment is one of optimism. The publication of the Government estimate of the crop values for the year has had a distinctly encouraging effect. According to the figures compiled by the Government statistician, the combined values of the crops of wheat, oats and barley will amount to $100,000,000 more than that of last year. Crop conditions are about average, and the acreage in almost all directions has been increased. In the industrial world there continues to be a distinct improvement. Iron and steel companies all over the country are so busy that they confidently predict they will be delivering normal output by the middle of the fall. There has also been a decided betterment in the pig iron situation, and the production is now running at a rate of 23,000,000 tons a year. The average price for finished steel materials is about $4 per ton lower than at the beginning of the year. There is also considerable more activity in the copper and electrical industries, and this is reflected in the betterment of the copper market. In textiles and in boots and shoes orders are reasonably plentiful. Collections continue to be only fair. Business failures for the week ended June 10, as reported by *Bradstreet's*, were 197 compared to 191 the previous week, 253 in 1908, 161 in 1907, 170 in 1906 and 175 in 1905.

THE COPPER MARKET.

The features of the past week in the copper market have been the very heavy speculative transactions and the heavy purchases, presumably by domestic consumers. Although official prices of copper show no change for the week, there was a downward tendency during the last few days. Strange as it may seem, a decline always checks the buying of local consumers. They appear to prefer purchasing on an advancing market, and immediately stay out when a decline begins. There is no doubt, however, that producers have disposed of large quantities of copper to dealers, speculators and consumers. The actual consumption is, of course, greater than it has been during the past few months, but is not anything like sufficient to utilize the quantities of copper that are now being purchased. The output continues to be unprecedented, and the fact that the statistics of the producers show a decrease in the surplus is due principally to the shifting of the stocks into the possession of second hands. It is estimated by some of the selling agencies that the total sales during the month of May in this market aggregate between 175,000,000 and 200,000,000 lb. If this be true, there must be some very heavy stocks in other hands than those of the producer. Imports continue to be liberal, and exports are very heavy. During the month of May the exports amounted to 31,473 tons, as compared with 22,640 tons in May, 1908. The tone of the market is very satisfactory to the producers, and there is no longer any talk current of combinations for the purpose of curtailment. Prices on the Metal Exchange June 14 were:

Lake	13⅝ @ 13¾
Electrolytic	13⅜ @ 13½
Casting	13¼ @ 13⅜

The London prices May 14 were as follows:

	Noon.	Close.
	£ s d	£ s d
Standard copper, spot	59 12 6	59 10 0
Standard copper, futures	60 10 0	60 7 6
Market	Weak.	Easy.
Sales of spot		1,100 tons
Sales of futures		1,400 tons

Extreme fluctuations for this year:

	Highest.	Lowest.
Standard	.....	.....
Lake	14.55	12.55
Electrolytic	14.25	12.12½
Casting	14.12½	12.00
London, spot	£64 2 6	£54 12 6
London, futures	64 17 6	55 10 0
London, best selected	67 15 0	59 0 0

MR. WESTINGHOUSE REVIEWS EUROPEAN CONDITIONS.—George Westinghouse returned from Europe last week after a trip that lasted more than three months. Regarding conditions in the electrical and engineering trades he had this to say: "There has been a notable improvement within 60 days in Germany, France, Belgium, Italy, Austria and Great Britain as well as a fair degree of improvement in most of the markets to which those countries export electrical engineering products. Engineers in charge of very large hydro-electric undertakings and the electrification of steam railroads told me that work in process will require something more than 125,000,000 lb. of copper within a twelvemonth. So far as I could learn stocks of high conductivity copper in Europe are small. In Germany much is being done in the making of ocean cables. One concern in Cologne will work up 15,000 tons of American copper this year in ocean cables. Italy and Switzerland are doing a great deal of work in hydro-electric power plants for industrial purposes and in the electification of steam railways. A dozen nations in Europe that until lately were large importers of coal are carrying out hydro-electric plants that will reduce their imports of coal for steam power making at least 75 per cent."

GENERAL ELECTRIC BUYS GERMAN TUNGSTEN PATENTS.—Although no formal announcement of the fact has been given out, the General Electric Company has purchased the patent rights to the Just-Hanaman and Kuzel tungsten lamps for America and certain other countries outside of Europe. Negotiations for these purchases have been pending for several months, and were finally brought to a successful conclusion a few weeks ago. These lamps, which have been imported for some time, will hereafter be manufactured in this country by the General Electric Company. The contracts for the sale of these lamps which already exist in this country will not be interfered with. The Electrical Accessaries Company, 1135 Broadway, New York, which has heretofore handled the Just lamp, will continue to import under license. The customers of this company have already been notified of the change. As far as could be learned, no special arrangement has as yet been agreed upon for the importation of Kuzel lamps to the United States.

ELECTRICAL CONSTRUCTION.—Among the items printed under Construction Notes in the present issue are announcements of proposed new plants or considerable extensions of present plants at Minneapolis, Minn.; Walla Walla, Wash.; Northfield, Minn.; Hazleton, Pa.; Pittsburgh, Pa.; Ainsworth, Neb.; East Jordan, Mich.; Claresholm, Alta., Can.; Portland, Ore.; Salt Lake City, Utah; Graniteville, Cal.; Allentown, Pa.; Dayton, Ohio; Jefferson, Okla.; Orange, Tex.; Kernersville, N. C.; Dothan, Ala.; Mackay, Idaho; Broken Bow, Neb.; Kenton, Ohio; Monette, Ark.; Murfreesboro, Ark., and Delphos, Kan.

MARKET FOR POWER-TRANSMISSION MACHINERY.—An American consul in Africa reports that there is a demand in his district at the present time for power-transmission machinery of various kinds, and firms in the United States desiring to compete for the business in this line of equipment should lose no time in communicating with and sending catalogs and other information to the mining companies and local supply houses, a list of which has been forwarded by the consul and may be obtained by manufacturers and dealers interested in exporting electrical apparatus for power-transmission from the Bureau of Manufacturers, Washington, D. C. The record number of this inquiry is 3501.

ELECTRICAL NOVELTIES FOR FRANCE.—M. Henri Rousseau, 225 rue de la Victorie, Brussels, Belgium, writes that he has taken up the importation of electrical novelties and accessories, and desires to receive the catalogs of manufacturers in these lines.

CATALOGUES WANTED.—C. Norton Parsons, 19 Terryville Avenue, Bristol, Conn., desires to receive catalogs pertaining to his business, which relates to electrical, mechanical and heating engineering.

NEW WIRELESS STATIONS.—The United Wireless Telegraph Company has issued lists of the commercial stations equipped with its system, which include 72 land stations, 171 boats and 51 steamship lines. In addition the company has equipped a large number of war vessels, and several army and navy shore stations. The company has recently fitted up five warships, and has also contracted with the Government to build three high-power stations along the Yukon River in Alaska. The apparatus for these stations will be shipped from Seattle Aug. 1. The installations will be of 5 kw each, and will complete a chain of Government Alaskan wireless stations. The company has recently equipped the *Joseph Henry* cable ship of the United States Signal Service, with a wireless outfit. Speaking of the reported developments in South and Central American states, an official of the company said that while it was true that negotiations had been pending for some time with Venezuela for the erection of stations along the coast, and that Samuel Greenbaum, who was representing the Venezuelan interests, had been in the city discussing the matter, no contract for this work had yet been made. An American company has been organized in Porto Rico, and expects to be granted a concession for telegraphic service on July 15. This service will be equipped by the United Wireless Company, and Frederick W. Midgeley, one of the engineers of the company, is now in San Juan preparing for the installation. The company has recently sold to the Salt Lake Railroad a 2 kw apparatus for its plant at San Pedro, Cal. The Los Angeles station of the wireless company, is about to be enlarged by the addition of a 5-kw installation.

ORDERS FOR LARGE DIRECT-CURRENT GENERATORS.—The Crocker-Wheeler Company has recently received several orders for large direct-current generators. One of these is for a 1500-kw, 550-volt generator to be used in the machine shop department of the Union Stock Yards of Armour & Company, Chicago. A similar machine of 800 kw, 575 volts, goes to Landers, Frary & Clark, New Britain, Conn. Warner Brothers Company, of Bridgeport, Conn., has ordered two generators, one 150 kw and one 329 kw, each 235 volts. Among the other sales of apparatus that the same company has made are: One 150 kw, 125-volt to the Keystone Steel & Wire Company; one 140 kw, 240-volt, and six 15-hp 230-volt motors to the Napier & Mitchell Manufacturing Company, Belleville, N. J.; one 125-kw, three-phase, 60-cycle, 240-volt alternating-current generator to the Cleveland Worsted Mills Company, Cleveland, Ohio; one 165-kw, three-phase, 60-cycle, 240-volt generator to the Miami Valley Works, Hamilton, O.; two 110-hp, 230-volt direct current motors have been sold to the Illinois Steel Company, South Chicago, Ill. A sale amounting to 247 hp in 220-volt, direct-current, series wound crane motors has been made to the Northern Engineering Works at Detroit. A number of sales of smaller apparatus have been made by the same company to manufacturing concerns throughout the West.

DENIAL OF GENERAL ELECTRIC COMPANY DEAL.—There has been recently revived in the daily newspapers the report which from time to time seems to go the rounds that the General Electric Company had either purchased or was negotiating for the heavy machinery manufacturing department of the Western Electric Company at Hawthorne. Regarding this deal, an official of the General Electric Company had this to say: "You may deny that story in toto; there is no such deal either completed or pending. That is all that it is necessary to say about it." The same expression was obtained at the headquarters of the Western Electric Company, where a representative of the company declared that there was nothing at all in the rumor. "Every time the Western Electric sees fit to turn down an order," said he, "or to refuse to bid for an order of extra heavy machinery, simply because our plants are busy making lighter apparatus, some one comes forward with this report that we have sold out. There is nothing in it, and as far as the published story is concerned that a number of our old employees in this department had been laid off, that also is untrue. So far as I know, only two old employees have quit, and they did so because they were offered better positions elsewhere."

BRITISH WESTINGHOUSE ELECTRIC COMPANY.—The annual meeting of the British Westinghouse Electric & Manufacturing Company, Ltd., was held May 24 in London. The chairman of the board of directors announced that the profits from the year's business had been more than absorbed by the interest charges, owing to the falling off of orders, due to the universal depression in business. The volume of orders, he stated, had been smaller, and the severe competition for business had greatly reduced the profits. As to the prospects for the coming year, he said that at the present time Great Britain was manufacturing electrical apparatus largely in excess of the demand of the home markets, and that the hoped for increase in the volume of orders depended almost entirely upon the export business. This, he stated, at the present time was not very bright, as there seemed to be a general depression all over the world, and as the competition was so sharp among the various exporting countries. He spoke urgently in favor of the standardization of electrical manufactures in Great Britain, and claimed that this tendency had done much to develop the industry in Germany and America.

NEW HAVEN ELECTRIFICATION PLANS.—W. S. Murray, electrical engineer of the New York, New Haven & Hartford Railroad Company, announces that it is the intention of the company to electrify its entire line from New York to New Haven; the electric zone now runs only to Stamford. Mr. Murray also says that the company intends to electrify the Harlem River branch, which runs from the Harlem River at 129th Street to New Rochelle. It is proposed that four tracks on each of these roads will be electrified. The Public Service Commission, it is said, will offer no objections when application is made for the electrification of the entire system in New York. It is expected that work will be completed in about 18 months. It was decided at the directors' meeting June 12 that the electrical extension should first be operated for freight, and later for passengers. The directors voted at the same meeting to contract for the work, which will cost $20,000,000, by open competition. It was expressly denied that any contract had been made with the Westinghouse company.

MISSISSIPPI RIVER DEVELOPMENT.—H. L. Cooper, of the engineering firm of Cooper & Powelson, of New York, has recently been making investigations with a view to building a dam and constructing a power plant on the Mississippi River near Keokuk, Iowa. John R. Freeman, of Providence, R. I., is consulting engineer of the enterprise. It is stated that there is water-power available at this point which may ultimately reach an output of about 200,000 hp. When a statement was asked from Mr. Cooper concerning the possibilities of this project, he said that at this time he was not prepared to give out any definite information.

SMALL VACUUM CLEANING MACHINE.—An American consular officer in a city of Western Europe reports that a local hardware dealer has applied to him for the names of American manufacturers of a small vacuum cleaning machine. The inquirer desires catalogs, price lists and full particulars regarding this article and forwards a cut representing the type of machine in which he is particularly interested, which can be obtained by interested firms from the Bureau of Manufactures, Washington. The record number of the inquiry is 3504.

LOUISVILLE-CINCINNATI TROLLEY PROJECT.—Announcement has been made by J. M. Andrews, president of the Indianapolis & Louisville Traction Company, that plans have been perfected for the immediate construction of a branch line from Scottsburg, Ind., to Madison, Ind., where connection will be made to Aurora, Lawrenceburg and Cincinnati. This company already operates a through service from Louisville to Indianapolis, Scottsburg being one of the points upon this line.

ELECTRIC TRAMWAY SUPPLIES.—A report has been received from an American consular officer in an European country, advising that a new electric line is to be constructed in his district. For the installation of this new electric tramway, which is to be completed within the next two years, all supplies are needed, and correspondence regarding the same should be addressed to the firm named in the report. The record number of the inquiry is 3499.

NEW WATER-POWER ENTERPRISE IN ARKANSAS.—The Garland Power & Development Company has been chartered at Little Rock, Ark., with a capital of $1,500,000, to establish a hydro-electric plant on the Ouachita River. It is proposed that the new company shall furnish power to the counties of Pulaski, Saline, Garland and Hot Springs.

WESTERN ELECTRIC COMPANY'S BUSINESS.—The business of the Western Electric Company, it is reported at the New York headquarters, is practically up to the normal capacity of the plants. The business, it is claimed, is particularly satisfactory from the fact that it is running largely to numerous orders of small apparatus rather than to large orders of heavier stuff. This class of business, it is said, is much more profitable. The company is kept busy making generators of less than 500-kw capacity, and small motors for individual machines in various factories are being very generously ordered. In addition to this, the telephone companies all over the country are making improvements and additions, and the number of orders for switchboards that have been received recently are very gratifying. Some good-sized orders for telegraph appliances have also been received, one from a Western railroad for wire, insulators and such material amounting to more than $100,000. The hydro-electric power plants are also buying equipment. Preliminary returns for May show that business is running at a rate of about $47,000,000 per year.

WHITNEY COMPANY'S AFFAIRS IN BETTER SHAPE.—A telegram from Salisbury, N. C., announces that an order has just been filed in the case of T. A. Gillespie & Company, of Pittsburgh and New York, against the Whitney Company, which allows the claim of Gillespie & Company in full, establishes the lien of $300,000 as a prior lien over the mortgage held by the Bankers' Trust Company, of New York, and practically amounts to a settlement of the claim. This is taken to mean that work will at once be resumed upon the water power plant, which, it is said, will be one of the largest in the United States when completed. In the meantime, the sale of the apparatus upon which the General Electric Company had a lien, which was announced for June 14, at Schenectady, has been postponed until June 28 at the same place, and an order of court has been issued to this effect. The postponement was made in order to give prospective purchasers more time to examine the apparatus that is to be offered.

BERGMANN WINS IN GERMAN CABLE WAR.—In February of the present year a combination which had existed among German manufacturers of insulated wire and cables for electric lighting and power purposes, was dissolved in consequence of inability to arrive at an agreement with an outside competitor, the Bergmann Electric Works Company, which had shortly before entered this field of manufacture. The rivalry which followed became so keen that prices were reduced below cost of production. It is now announced that the combination has been restored, with the Bergmann company as a member, under an agreement which holds until Dec. 31, 1914. The terms of the agreement affect only German consumers.

FRENCH WESTINGHOUSE COMPANY.—An official of the Westinghouse Electric & Manufacturing Company who has recently returned from abroad announces that the French Westinghouse Company has enjoyed a profitable business during the past year, and that the prospect is correspondingly bright for the coming year. At the regular meeting of this company this week it is expected that the annual 5 per cent dividend will be declared on the preferred stock. The recent increase of this stock by the addition of $5,000,000 does not decrease the available surplus for dividends, as the proceeds of this sale of stock was used to take up a like amount of notes upon which interest was being paid.

SALE OF ANIMAS POWER & WATER COMPANY.—The recent sale at Durango, Col., of the plant of the Animas Power & Water Company, on the Animas River, between Durango and Silverton, is made the occasion of an attack by the *Denver Times* on the General Electric Company, the purchase being stated to be part of the plan of that company, and interests allied with it to form a gigantic monopoly of the water-power resources of the country. No facts, however, to support the charge, are given. The Central Colorado Power Company is stated to be controlled by the same interests that purchased the Las Animas plant.

ELECTRICAL SUPPLIES WANTED BY THE ISTHMIAN CANAL.—The general purchasing officer of the Isthmian Canal Commission at Washington has advertised for various electrical supplies, the bids to be opened June 22 in Washington. These include distribution boxes, fuses, plugs, cut-outs, switches, etc. Also lamp fittings for marine use, incandescent lamps, enclosed arc lamps, carbons, insulated cable, copper wire, enameled iron conduits, wire solder, copper cable and various other small electrical appliances.

MILWAUKEE WESTERN ELECTRIC RAILWAY.—A contract has been awarded for the construction of the Milwaukee Western Electric Railway, which will run northwest from Milwaukee. Work upon this line will begin in September. The road will be 55 miles long between Milwaukee and Beaver Dam, with a branch of 10 miles from Sussex to Waukesha.

Financial Intelligence.

THE WEEK IN WALL STREET.

The stock market in Wall Street during the past week was one of the most active that we have had since the beginning of the time of depression. Sentiment from the beginning to the end was strong, but this does not mean that all stocks advanced. The highly professional character which has been developed in the recent market within the past year continues to be in evidence, and under such circumstances on every advance there appears to be a considerable amount of selling in order to take in profits. This selling always results in temporary reactions, and while last week some stocks advanced, others declined. The tone, however, is upward, and whether a security advanced or declined was simply due to whether the speculators had loaded up at a low figure, and were anxious to get out, or whether the stock had been originally taken by investors. Steel stocks were not quite so active as they were during the previous week, but this is due to the fact that they are largely handled by manipulators, who were ready to take their profits. General conditions in Wall Street are very favorable to a strong and advancing market. The Government crop report while unsatisfactory in spots, indicated that the total amount of money to be received by the farmers this season would be larger than in any year in the history of the country. Of course, it is the total results that interest Wall Street. The market for securities, especially mortgage bonds, was never better than at the present time, although proposed issues are not as largely oversubscribed as they were a few months ago. In the first five months of the year $172,000,000 of industrial bonds had been floated, while in the same period of 1908 less than $50,000,000 were floated. This shows that the country not only has plenty of money, but that it is willing to take hold of industrial investments. The money market has shown no change. It continues to be remarkably cheap as to rates, and remarkably plenty as to cash. Quotations on June 14 were call 1½ @ 1⅞ per cent, 90-day 2½ @ 2¾ per cent. The quotations in the table are those of the close May 14:

NEW YORK.

	June 7.	June 14.	Shares sold.		June 7.	June 14.	Shares sold.
All.-Ch.	15¼	16	2,500	Int.-Met., pfd.	45¼	46⅜	9,720
All.-Ch., pfd...	52⅜	54	3,450	Mackay Cos...	82⅜	81½	1,900
Amal. Cop....	87	85⅞	118,770	M'c'ky Cs., p.	74¾	75⅛	750
Am. D. T.....	29*	29*	———	Man. Elev....	146½*	144	.....
Am. Loc.....	61⅝	60½	13,400	Met. St. Ry..	29*	29*	.....
Am. Loc., pfd.	117	117¾	1,210	N.Y.&N.J. Tel.	124	124	425
Am. Tel. & Cbl.	79	80*	200	Steel, com....	67¼	69½	547,767
Am. T. & T..	140⅝	142½	55,222	Steel. pfd.....	125	125¾	36,718
B. R. T.....	81¼	80¼	36,680	W. U. T.....	76½	75	12,244
Gen. Elec.....	160	163½	12,500	West'h, com..	85	86⅛	16,120
Int.-Met. com..	16½	17	6,300	West'h, pfd...	123	122*	300

PHILADELPHIA.

	June 7.	June 14.	Shares sold.		June 7.	June 14.	Shares sold.
Am. Rys.....	45¾	45¾	———	Phila. Elec...	11⅞	11⅞	———
Elec. Co. of A.	12½	12½*	———	Phila. R. T...	32	27⅞	———
Elec. St. B'ty.	52½	54½	———	Phila. Trac...	92*	91	———
E. S. B'ty. pfd.	49*	49*	———	Union Trac...	56¾	52⅞	———

CHICAGO.

	June 7.	June 14.	Shares sold.		June 7.	June 14.	Shares sold.
Chi. City Ry..	180*	180*	———	Chi. Tel. Co..	133¼	134	———
Chi. Rs., Ser.1.	107½	107*	———	Met. El., com.	19*	19*	———
Chi. Rs., Ser.2.	38½	36½*	———	Met. El., pfd.	54*	54*	———
Com. Edison..	119½	119½	———	Nat'l Carbon...	93	93½	———
Chi. Sub'ws...	24½	25*	———	Nat'l C., pfd...	119*	118	———

BOSTON.

	June 7.	June 14.	Shares sold.		June 7.	June 14.	Shares sold.
Am. T. & T...	140⅝	142⅜	———	Mex. Tel.....	3*	3	———
Cum. Tel.....	136¼	136*	———	Mex. Tel. pfd.	5½*	6⅛	———
Edison. E. Ill..	248	249	———	N. E. Tel....	133	133	———
Gen. Elec.....	160	163½	———	W. T. & T....	11¾	11½*	———
Mass. E. Ry...	12½	12*	———	W. T. & T., p.	87*	87	———
Mass E. R., p.	67½	67¼	———				

*Last price quoted.
Shares sold are for week June 7 to June 12.

DIVIDENDS.

Boston & Worcester Electric Company, preferred, semi-annual, 1 per cent, payable July 1.

Detroit Edison Company, quarterly, 1 per cent, payable July 15.

Duluth (Minn.) Edison Electric Company, preferred, quarterly, 1½ per cent, payable July 1.

Fonda, Johnstown & Gloversville (N. Y.) Company, preferred, annual, 6 per cent, payable June 15.

Louisville Traction Company, quarterly, 1 per cent, payable July 1.

Manila Electric Railway & Lighting Corporation, quarterly, 1 per cent, payable July 1.

Otis Elevator Company, preferred, quarterly, 1½ per cent, payable July 15.

Reading (Pa.) Traction Company, semi-annual, 1½ per cent, payable July 1.

St. Joseph (Mo.) Railway Light, Heat & Power Company, preferred, quarterly, 1¼ per cent, payable July 1.

Union Traction Company, Philadelphia, semi-annual, 3 per cent, payable July 1.

United Gas Improvement Company, Philadelphia, quarterly, 2 per cent, payable July 15.

United Traction & Electric Company, Providence, R. I., quarterly, 1¼ per cent, payable July 1.

Washington Water Power Company, quarterly, 1½ per cent, payable July 1.

Western Union Telegraph Company, quarterly, ¾ per cent, payable July 15.

Winnipeg Electric Railway Company, quarterly, 2½ per cent, payable July 15.

McCALL FERRY POWER COMPANY REFINANCING.—A plan has been announced for refinancing the McCall Ferry Power Company, by the committee which has had the reorganization in charge. The plan provides that either the present company be readjusted or that a new company be formed which will be known as the Southern Pennsylvania Power Company. It is proposed to issue $12,500,000 first mortgage 5 per cent bonds to run 30 years. An amount not to exceed $4,250,000 of these is to be sold at 90 to obtain additional money for the completion of the plant. The plan proposes that the present bondholders shall receive 40 per cent of their present holdings in the new issue, amounting to $3,330,000. This will leave $4,920,000 in the treasury for future purposes. It is also proposed to issue new capital stock to the amount of $8,500,000, of which $3,500,000 will be used as a bonus to the purchasers of the new bonds. Under this arrangement the present bond holders will receive about 60 per cent. It is proposed that the new stock shall be placed in a voting trust which will not terminate until Nov. 1, 1912, It is claimed that this plan not only gives the present security holders ample bonus for the protection of what has already been invested in the enterprise, but it provides for future needs by retaining a satisfactory amount in the treasury. It is stated that outsiders, not now interested in the company, have agreed to take $4,170,000 of the new bonds. If this refinancing plan goes through it is promised that the dam and power stations will be completed early next year. A transmission line will then be immediately constructed into Baltimore.

JOHN D. RYAN HEADS AMALGAMATED COPPER.—At the meeting of the board of directors of the Amalgamated Copper Company last week, John D. Ryan was elected president, to succeed the late H. H. Rogers. No other changes in the officers of the company were made. Mr. Ryan has for many years been managing director of the company, and has practically had entire charge of all Mr. Rogers' copper interests. He is one of the best posted and most capable copper men in the country, his entire life having been devoted to the industry. Following his election Mr. Ryan resigned as president of the Anaconda Copper Company, and was succeeded in that position by Benjamin B. Thayer, who had been the assistant of President Rogers of the Amalagamated Company. Mr. Ryan has for a long time been associated with Thomas F. Cole in a number of mining enterprises in Montana, and recently organized the International Smelting & Refining Company, of which he is president, to compete with the American Smelting & Refining Company. He has given notice that it is the intention of his new smelting company to construct plants all over the West, and to be able to handle ore from almost every camp.

CONSOLIDATION AT CHATTANOOGA.—The plan for the consolidation of the Chattanooga Electric Company and the Chattanooga Railways Company, which has been heretofore referred to, has been officially given out by E. W. Clark & Company, Hodenpyl, Walbridge & Company and Graham & Company. It is stated that more than 90 per cent of the preferred stock and more than 90 per cent of the common stock of the railways company have assented to the plan. The Trust Company of North America, New York, will receive the deposits of stock. The capitalization of the new company will represent $2,690,000 railways bonds, and $1,038,000 electric company bonds, for which the proposed new mortgage issue will be made. There will also be $2,000,000 of 5 per cent cumulative preferred stock and $3,000,000 of common stock. The Chattanooga Railways preferred stock will be replaced by the new preferred stock share for share, and the common stock will be replaced with $25 in cash and $50 in the new common stock.

THIRD AVENUE REORGANIZATION PLAN.—A plan for the reorganization of the Third Avenue Railroad system has been submitted informally to the Public Service Commission, and is now under consideration. It was prepared by the bondholders' committee, of which J. N. Wallace is chairman. While the details of the plan were strictly guarded, it is understood that it involves rather heavy assessments upon the stockholders, and provides for an exchange of the present outstanding bonds on a basis of part bonds and part stock in the reorganized concern. F. W. Whitridge, receiver of the road, estimates that the betterments, which are absolutely necessary to put the line in good physical condition, will cost about $7,500,000, a portion of which has been already spent. In addition to this, the city has a claim of almost $1,250,000 for franchise taxes. Between 85 and 90 per cent of the bonds of the company have been already deposited with the protective committee.

TOLEDO RAILWAYS & LIGHT COMPANY.—It is given out by the bondholders' committee of the Toledo Railways & Light Company that the plan for reorganizing the property and for taking care of the indebtedness which matures in July has been successfully carried out. Under the plan as announced, the maturing bonds will be extended two and one-half years at a higher rate of interest, while a protective committee will look after the interests of the stockholders. The banking firm of Blair & Company, which is a large holder of the two batches of bonds, is practically backing the reorganization, and there appears to be no longer any doubt that the indebtedness of the company will be so well cared for that no litigation will be possible. It is also believed that there will be no serious difficulty about securing an extension of the various franchises, the trouble over which has caused the company its present embarrassment.

MASSACHUSETTS ELECTRIC COMPANIES EARNINGS.—For the first five months of the current year the earnings of the Massachusetts Electric Companies have shown an increase of $53,544, or 1.6 per cent. This improvement has all been made in the past three months as the first two months fell below the same months last year. Thus far the operating companies have applied to the railroad commission for permission to issue $2,800,000 of new securities. A portion of the money thus raised has been used to pay off floating indebtedness but the bond issues now pending are to provide for betterments and improvements. When the work now in hand is completed the total expenditure of the company will amount to upward of $21,000,000.

AMALGAMATION PLAN AT SPRINGFIELD, ILL.—Announcement has been made that E. W. Clark & Company, of Philadelphia, and Hodenpyl, Walbridge & Company, of New York, have recently acquired control of the stock of the Rockford (Ill.) & Interurban Railway Company, and expect to make a consolidation of that property with the Springfield Railway & Light Company, the Peoria Light Company and the Evansville Light Company. A plan has been perfected to this effect, and the new company will be known as the Union Railway, Gas & Electric Company. The Bankers' Trust Company, of New York, is one of the depositories for the transfer of stock.

NATIONAL CARBON STOCK LISTED IN BOSTON.—The recent listing of the preferred and common stock of the National Carbon Company on the Boston Stock Exchange was done because the securities are largely held by New England investors. At least 20 per cent of the company's shares are placed in that section. The stability of the company's business makes it popular. As the majority of the customers are municipalities or public service corporations the earnings are little affected by periods of depression.

NEW YORK STATE RAILWAYS CAPITAL INCREASED.—Application has been made to the Public Service Commission of the Second District of New York by the New York State Railways Company, which controls a number of trolley properties in central New York, for permission to increase its capital stock from $23,140,200 to $23,850,200, to purchase and acquire the stock of several other railroad properties. Application has also been made to execute a consolidated and refunding mortgage on its property rights and franchises to secure a $35,000,000 issue of bonds. It is proposed to issue at this time only $6,500,000 of these bonds, which will be used for refunding the outstanding bonds of the Rochester & Eastern Rapid Railway Company, and to acquire the Rome City Railway Company and the notes of a few other companies. This financing is a part of the plan for the consolidation of all the trolley interests in central New York.

POPE MANUFACTURING COMPANY IN GOOD SHAPE.—Having completed the sale of unnecessary properties and concentrated its manufacturing in the two plants at Hartford, Conn., and Westfield, Mass., the Pope Manufacturing Company is now said to be in excellent financial condition. Of the $800,000 6 per cent notes issued under the reorganization plan, $267,000 maturing in 1911 have been redeemed, and now the property sale has made it possible to take up the remaining $533,000. The company's business has recently shown a vast improvement. The demand for automobiles has increased, and it is claimed that the output of cars for the current year will be double that of 1908. With the notes retired, the company has to earn only $150,000 to meet the requirements of its $2,500,000 cumulative 6 per cent preferred, and all above that can be devoted to dividends upon the $4,000,000 common stock.

BUTTE ELECTRIC & POWER COMPANY.—It is reported from Montana that the Butte Electric & Power Company, of which C. W. Wetmore, of St. Louis, is president, has acquired a half interest in the $2,500,000 stock of the Great Falls Water Power & Townsite Company, in which John D. Ryan and Thomas F. Cole are heavily interested. The Great Falls company has established a hydro-electric plant of 8360 hp, and is building a second plant which it is estimated will net 36,000 hp. These plants will furnish power to the mines and smelters of the Amalgamated Copper Company. The Butte Electric & Power Company is also furnishing energy in this field, and the purchase above referred to is in the nature of a consolidation of interests. The purchase which the Butte Electric Company has recently made also gives it control of the electric railway and lighting systems of Great Falls, Mont.

LACLEDE GAS LIGHT DEAL CARRIED THROUGH.—Official announcement has been made that the North American Company's holdings of the common stock of the Laclede Gas Light Company, of St. Louis, have been sold to G. H. Walker & Company, St. Louis, and William Salomon & Company, of New York. These firms represent a purchasing syndicate, made up of St. Louis men, among whom are Adolphus Busch and John I. Beggs, of Milwaukee, the present head of the company. The syndicate is closely identified with the North American Company. Alanson Lathrop, president of the American Light & Traction Company, says that his company is not interested. It is said that John I. Beggs will remain as president of the company.

WESTERN UNION EARNINGS GROWING.—At a meeting of the Board of Directors of the Western Union Telegraph Company last week, an estimate of the income from operations for the present quarter was made, which shows that it will probably exceed $1,700,000; this compares with $1,684,000 for the first quarter of the year, and $1,579,000 for the corresponding quarter in 1908. After paying interest on the bonds there will be left $1,266,000, or 1¼ per cent on the company's stock. This stock has been paying quarterly only ¾ of 1 per cent. In a statement made to the board of directors, President Clowry estimated that the net earnings of the company for the fiscal year would amount to 5½ per cent on the stock.

ELECTRIC VEHICLE SETTLEMENT ACCEPTED.—An order has been entered in the United States Court at Trenton authorizing Halsey M. Barrett and Henry W. Nuckels, receivers of the Electric Vehicle Company, to accept the offer of $430,000 cash from the receivership committee, of which Herbert Lloyd is chairman. The offer provides that the committee will also pay all of the accruing debts of the present receivership until its termination. Under this plan of reorganization the bondholders will receive 20 cents on the dollar, which it is claimed is double the amount that would have been received had the company been liquidated.

COMPLETING STANISLAUS ELECTRIC POWER DEAL.—Articles of incorporation have been filed in San Mateo County, California, for the Sierra & San Francisco Power Company. This is the new concern that has been organized by the United Railways interests to absorb the recently purchased Stanislaus Electric Power Company. The capital stock authorized is $20,000,000, of which $1,000 was subscribed. The organizers named are members of the law firm that has handled the deal for the United Railways Investment Company. The new company takes over the Stanislaus and its subsidiary companies.

AMERICAN PNEUMATIC SERVICE COMPANY.—At the annual meeting of the American Pneumatic Service Company in Chicago last week W. H. Ames was elected president, and the date of the annual meeting was changed from the last Friday in May to the last Friday in June, so as to allow more time to prepare the annual report. It was voted at the meeting to appropriate the money to build a tunnel under the Chicago River for the purpose of re-establishing the mail service of the Chicago & Northwestern Railway.

HAVANA ELECTRIC RAILWAY.—At the monthly meeting of the directors of the Havana Electric Railway last week a plan for retiring $5,000,000 of 6 per cent preferred stock was considered. After the meeting it was announced that the details of the plan had not been worked out, but that some action was likely to be taken in this direction before the end of the year. It was stated that the company's affairs showed a steady improvement, and that conditions in Cuba were generally satisfactory.

REPORTED CONSOLIDATION OF ELECTRICAL CONCERNS.—A financial paper in New York published last week a report that a number of the smaller electrical manufacturing concerns were likely to enter into a combination, financed by London and Berlin bankers. It was expressly stated that these concerns did not include any of the large companies. Investigation of the story developed no confirmation of the report, which does not appear to have even a basis in rumor.

TO CONTEST INCREASE OF FARE.—The City Council of Philadelphia has adopted a resolution directing the city solicitor to begin legal proceedings at once to determine the right of the Philadelphia Rapid Transit Company to discontinue the sale of six for a quarter tickets without the consent of the city. The Council also adopted a resolution demanding that the old rate of ticket sales be restored.

EASTHAMPTON (MASS.) PLANT SOLD.—Boston financiers connected with the Connecticut River Power Company have notified the Easthampton Gas Company that they will exercise their option on the company's stock. They agree to pay $200 a share, par $100. The capital stock is $50,000. The electrical plant will be connected with the Connecticut River plant at Turners Falls.

REPORTS OF EARNINGS.

	Gross earnings.	Expenses.	Net earnings.	Charges.	Surplus.
Amalgamated Copper Company:					
Year ended April 30, 1909	.....	.....	$3,663,980	$3,077,758	$586,222
Year ended April 30, 1908	.....	.....	6,680,557	6,155,516	525,041
Geneva, Waterloo, Seneca Falls & Cayuga Lake(N. Y.) Traction Company:					
Quarter ended March 31, 1909	$18,002	$14,260	3,742	6,000	*2,479
Quarter ended March 31, 1908	17,412	13,733	3,679	4,500	*1,130
Montreal Light, Heat & Power Company:					
Year ended April 30, 1909	4,079,769	1,844,653	2,235,116	489,268	1,745,848
Year ended April 30, 1908	3,792,318	1,651,656	2,140,562	493,090	1,647,467
West Jersey & Seashore Company:					
April, 1909	412,128	305,035	108,825	26,679	82,145
April, 1908	410,570	314,656	95,914	26,679	69,234
Western Union Telegraph Company:					
Quarter ended June 30, 1909 (Est.)	.....	.....	1,700,000	433,062	1,266,938
Quarter ended June 30, 1908	.....	.....	1,579,660	433,062	1,146,598

*Deficit.

GENERAL NEWS

Construction News.

DOTHAN, ALA.—J. B. McCrary & Company, of Atlanta, Ga., have been engaged by the City Council to prepare plans and supervise the construction of the proposed municipal electric light plant and water works system, for which $20,000 in bonds was recently voted.

PHOENIX, ARIZ.—The Phoenix Railway Company is considering the question of extending its Indian School line for a distance of about 2¼ miles.

HIGGINSON, ARK.—The Searchlight Power & Electric Company, recently incorporated, it is reported, will establish an electric light plant either in Higginson or Kensett. The company also proposes to establish a street railway system in Searcy. Louis Lorch is president.

MURFREESBORO, ARK.—The Pike County Water Power Company is preparing plans for the construction of a concrete dam across the Little Missouri River. It is proposed to develop from 20,000 to 40,000 hp for transmission by electricity to various cities. Claudius Jones, of Little Rock, Ark., is president.

MAMMOTH SPRINGS, ARK.—The Mammoth Springs Electric & Power Company, recently incorporated, is planning to construct a power plant and develop 950 hp, contracts for which have been awarded as follows: For electrical equipment, to the Westinghouse Electric & Manufacturing Company, of Pittsburgh, Pa.; water wheels, to James Leffel & Company, of Springfield, Ohio. J. A. Omberg, Institute Building, Memphis, Tenn., is engineer in charge.

MONETTE, ARK.—Plans have been completed for the installation of an electric lighting system in Monette. It is said that the Monette Lumber Company is interested in the project.

DEL MONTE, CAL.—The Del Monte Townsite Company has completed surveys and secured capital for the construction of an electric railway, three miles in length, from Monterey to Del Monte Heights. Contracts for the construction of the railway will soon be let. F. M. Fairchild, of Oakland, Cal., is chief engineer, and George W. Phelps, of San Francisco, president.

GLENDALE, CAL.—The Glendale & Eagle Rock Railway Company is negotiating with the Pacific Electric Railway Company for the purchase of its franchise for the distance between the terminus of its Glendale line and the terminus of the Glendale & Eagle Rock Railway. The last-named company has recently completed a railway between Glendale and Eagle Rock, 2½ miles in length, where it connects with the Los Angeles Railway running from Eagle Rock to Los Angeles. The Glendale & Eagle Rock Railway Company purchases electricity for operating its road from the Pacific Light & Power Company, of Los Angeles, Cal. E. D. Goode is president and treasurer of the Glendale company.

GRANITEVILLE, CAL.—Surveys are being made on the Middle Yuba River below Graniteville for the proposed electric plant to be installed by Dr. A. H. Tickell. It is said that the plant will be located above the Plumbago power house and will furnish electricity to the mines in Allegheny and Graniteville. Edward C. Uren, of Grass Valley, Cal., is engineer.

LOS ANGELES, CAL.—The Surf Light & Power Company, recently incorporated, with a capital stock of $1,000,000, proposes to erect a generating plant on the coast, probably between Santa Monica and Redondo, which will be operated by power obtained from the waves of the ocean. The plant will furnish electricity for lamps and motors to coast towns. Charles W. Hicks, J. L. Haley and others are interested in the project.

OAKLAND, CAL.—H. L. Boyle, representing the citizens of Fitchburg, has applied to the Board of Supervisors to have a lighting district formed in that place.

PASKENTA, CAL.—W. D. Russell, of Paskenta, has filed a notice of appropriation of 500 cu. in. of water from Bennett Creek to be utilized for irrigation and domestic purposes, and also for the generation of electricity.

POMONA, CAL.—The Pacific Electric Railway Company will construct a one and one-half mile extension to its railway in Pomona.

RED BLUFF, CAL.—E. W. Stores, of Tehama, has filed notice of appropriation of 20,000 cu. in. of water in Mill Creek to be diverted about 14 miles above the junction of Mill Creek with Little Mill Creek. The water will be utilized to generate electricity.

REDDING, CAL.—The Northern California Power Company, Consolidated, has taken over the C. W. Hamilton ranch and water rights, which includes 540 acres of land and about 850 in. of water running out of Battle, Mill and Brush creeks, which run through the property. Work has commenced on the construction of a new power plant which is designated "South," where 6000 hp will be obtained. The plant is located five miles south of the Volta power plant, where 9000 hp is generated. It is expected to have the plant in operation in July. Another plant will be erected farther down the stream which will be known as "Inkskip," where about 8000 hp will be obtained. The company expects to have all its installations completed by the end of 1910, which will give it a combined output of 51,000 hp.

SAN FRANCISCO, CAL.—It is reported that the Golden States Mines & Iron Works is planning to install a new electric generator in its plant.

SAN JOSE, CAL.—J. T. Burke, president of the San Jose, Los Gatos Interurban Railway Company and Peninsular Railroad Company, has secured a franchise on First Street for $11,000. It is said that the owner of the new franchise cannot construct a railway unless it can purchase the property of the San Jose Railway Company. The franchise of the San Jose Railway Company still has 13 years to run.

SANTA ANA, CAL.—Application has been made to the Board of Supervisors for a 25-year franchise to construct and operate transmission lines along certain highways in Orange County for the distribution of electricity for lamps and motors. Sealed bids for the franchise will be received by the Board of Supervisors until July 7. W. B. Williams is county clerk.

TRINIDAD, COL.—The power plant of the Southern Colorado Power Company was destroyed by fire June 5, putting the electric lighting system and street railway out of commission. The leading coal mines and coke ovens of the Colorado Fuel & Iron Company throughout the county are idle, owing to lack of power. The loss is estimated at $300,000.

NEW HAVEN, CONN.—The United Illuminating Company has submitted a proposition to the trustees of Yale University for furnishing electricity for lighting the campus and college buildings. The college authorities are considering the question of enlarging the two electric plants now maintained by the university.

LEWES, DEL.—The Board of Public Works is extending the municipal electric lighting system to the beach front.

WASHINGTON, D. C.—The Commissioners of District of Columbia have granted the Baltimore & Washington Transit Company permission to construct the extension of its railway within the District of Columbia.

WASHINGTON, D. C.—Bids will be received at the Bureau of Yards and Docks, Navy Department, Washington, D. C., until July 10, for furnishing generating equipment and ceiling fans at the naval hospital, Canacao, P. I. Plans and specifications can be obtained on application to the bureau. R. C. Hollyday is chief of bureau.

WASHINGTON, D. C.—Bids will be received at the Bureau of Supplies and Accounts, Navy Department, Washington, D. C., until June 29 to furnish at the navy yard, Mare Island, Cal., one electric traveling hoist and one electric freight elevator. Applications for proposals should refer to schedule 1304. Blank proposals furnished upon application to the Navy Pay Office, San Francisco, Cal., or to the above bureau.

WASHINGTON, D. C.—Bids will be received until June 26 at the Bureau of Yards and Docks, Navy Department, Washington, D. C., for furnishing and installing three 5000 cu. ft. air compressors and accessories at the navy yards at New York, Philadelphia and Mare Island, Cal. Specifications can be obtained on application to the bureau or to the commandants of the navy yards named. R. C. Hollyday is chief of bureau.

WASHINGTON, D. C.—Bids will be received at the Bureau of Yards and Docks, Navy Department, Washington, D. C., until July 10 (an extension of date from June 26) for furnishing and installing piping, pumps, condensers, heaters, etc., in the central power plant, navy yard, Puget Sound, Wash. Plans and specifications can be obtained on application to the bureau or commandant of the Navy Yard named. R. C. Hollyday is chief of bureau.

WASHINGTON, D. C.—Sealed proposals will be received at the Bureau of Yards and Docks, Navy Department, Washington, D. C., until July 10 (an extension of date from June 26) for furnishing one 1000-kw and two 1500-kw turbo-alternators for the navy yards at New York, Philadelphia and Boston. Specifications can be obtained on application to the bureau or to the commandants of the navy yards named. R. C. Hollyday is chief of bureau.

WASHINGTON, D. C.—The Washington, Baltimore & Annapolis Electric Railway Company has engaged the Cleveland Construction Company, of Cleveland, Ohio, to take charge of the reconstruction of its power system, changing it from 6600-volt alternating-current to 1200-volt direct-current. The work will include the construction of a new substation and installing new equipment at the present transformer stations, and also the erection of high-tension transmission lines and feed wires.

WASHINGTON, D. C.—The Commissioners of the District of Columbia have accepted the proposition of the Potomac Electric Power Company to light the streets of the city for a term of three years. The company offers to change the present 25-cp lamps for a lamp of from 35 to 40 cp for $20, the same rate that is now being paid; to maintain the present 40-cp lamps, reducing the price from $24 to $20 per lamp per year; to maintain the present 75-cp lamps at $30 each per year, instead of $41.25, as paid under the present contract; to reduce the price of 100-cp lamps from $50 to $35 per lamp per year, and to furnish and maintain four-glower Nernst

lamps on Connecticut Avenue Bridge at the rate of $65 each per lamp per year, and arc lamps at $85 per lamp per annum.

JENNINGS, FLA.—K. K. Powell is reported to be interested in a project to establish a telephone system in and around Jennings.

BAINBRIDGE, GA.—The Bainbridge Telephone Company has purchased the plant and holdings of the Brinson Telephone Company and is constructing a small exchange at Climax, and also many rural lines in all parts of this and Miller counties.

BRUNSWICK, GA.—The Mutual Light & Water Company, recently organized, will begin work in four months on a street railway system. The company has completed a boiler house and has ordered equipment for the same.

DOUGLASVILLE, GA.—Contracts for the construction of the proposed municipal electric light plant have been awarded as follows: For construction of plant, to Carter & Gillespie, of Atlanta, Ga.; electrical apparatus to the Fort Wayne Electric Works, Ft. Wayne, Ind., and to the Harrisburg Engine Company, of Harrisburg, Pa., for all steam equipment. The cost of the plant is estimated at $10,000.

ELBERTON, GA.—The Interstate Power Company, recently incorporated by Thomas J. Brown and E. Marvin Underwood, with a capitalization of $3,000,000, proposes to build a dam across the Savannah River in Elbert County.

LAWRENCEVILLE, GA.—The North Georgia Electric Company is reported to be considering the question of furnishing electricity in Lawrenceville from its plant at Gainesville. The company proposes to construct a cable line supported by steel towers, at a cost of about $15,000. W. A. Carlisle, of Gainesville, Ga., is president.

ROME, GA.—Arrangements are being made by the Rome Railway & Light Company to extend its railway system farther into the suburbs. The first extension will cost about $15,000.

SUMMERVILLE, GA.—The city is contemplating the installation of an electric light plant. C. D. Rivers is mayor.

WARRENTON, GA.—At an election to be held July 12 the proposition to issue $12,000 in bonds for the construction of an electric light plant will be submitted to a vote.

MACKAY, IDAHO.—The Mackay Light & Power Company, recently organized, is making preparations for the construction of a hydro-electric plant near Mackay. The initial equipment will include a 500-kw generator and turbine.

AURORA, ILL.—The Western United Gas & Electric Company, it is reported, will install an additional steam turbine, jet condenser, electric generator, exciter, etc., in the near future.

MONMOUTH, ILL.—Plans are being made by the Central Union Telephone Company to erect a new exchange building in this city at a cost of $60,000. The central energy system will be installed.

OTTAWA, ILL.—It is reported that W. D. Boyce, of Chicago, Ill., contemplates making application to the City Council for a franchise to furnish power to manufacturers in Ottawa.

VERMILION, ILL.—Plans are being made by the Vermilion Telephone Company for rebuilding the local telephone exchange and its lines throughout the country.

BRAZIL, IND.—The capital stock of the Citizens' Telephone Company has been increased from $50,000 to $100,000. M. J. Murphy is secretary and treasurer.

CHRISMAN, IND.—The Portage Home Telephone Company has increased its capital to $50,000, the proceeds to be used to make general improvements. J. J. Robinson is president and E. G. Miller secretary of the company.

KNIGHTSTOWN, IND.—Local business men are interested in a project to construct an electric railway from this city to Shirley, a distance of 23 miles.

LINTON, IND.—It is reported that the municipal electric light plant is to be sold to a Chicago company for $25,000. It is said that a majority of the Council is in favor of selling the plant and that a special meeting will probably be called soon to take action on the matter.

PERU, IND.—The Miami County Commissioners, it is reported, have decided to install an electric light, heat and power plant at the court house and jail, at a cost of about $40,000.

TERRE HAUTE, IND.—The Vandalia Railroad Company is planning to enlarge its terminal in this city and construct a large engine shop, which will involve an expenditure of over $500,000. The shops will be equipped to be operated by electricity.

BOONE, IA.—The Boone County Telephone Company has awarded a contract to the Automatic Electric Company, of Chicago, Ill., for a complete equipment of its plant, at a cost of $125,000.

CORNING, IA.—Plans are being made by the Middle Valley Mutual Telephone Company to rebuild its entire telephone lines.

HOUGHTON, IA.—The German-American Telephone Company has increased its capital stock from $3,000 to $50,000 and has changed its main office from Hamil to Houghton.

SPIRIT LAKE, IA.—The Midland Telephone Company is contemplating the erection of a new telephone exchange building.

DELPHOS, KAN.—Bids will be received by the city clerk of Delphos until June 23 for furnishing material and constructing a system of water works and electric light plant, separate bids being entertained as follows: 1. For furnishing material and labor (except cast-iron pipe, hydrants, valves, machinery and water tower) and constructing a complete water works system. 2. For furnishing cast-iron pipe and special castings. 3. For furnishing hydrants and valves. 4. For furnishing material and erecting steel tower and tank, capacity 50,000 gal., height 80 ft. to the bottom of tank. 5. For furnishing and erecting on foundations furnished by the city, one 25-hp and one 50-hp gasoline engines and accessories. 6. For furnishing and erecting on foundations furnished by the city one 20-kw and one 35-kw generator with exciter, switchboard and accessories. 8. For furnishing material and erecting electric light distributing system. Plans and specifications for the above work are on file at the office of the city clerk, Delphos, Kan., and at the office of the J. S. Worley Company, engineers, Kansas City, Mo. J. R. Adams is mayor.

JAMESTOWN, KAN.—Plans are being prepared for the construction of an electric light plant and water works system in Jamestown. Burns & McDonnell, Scarritt Building, Kansas City, Mo., are engineers.

ST. JOHNS, KAN.—The citizens at an election to be held June 18 will vote on the proposition to issue $37,500 in bonds for the construction of an electric light plant and water-works system, plans for which have been prepared by Burns & McDonnell, consulting engineers, Kansas City, Mo.

ALEXANDRIA, LA.—The electric light and water works committee has recommended a bond issue of $45,000, the proceeds to be used for extension and improvements to the electric light plant and water works system.

NEW ORLEANS, LA.—The New Orleans Railway, Light & Power Company is contemplating an extension of its railway to Spanish Fort, via the West End. Hugh McCloskey is president.

ALFRED, MAINE.—Bids will be received by the Alfred Embroidery Company, of Alfred, Maine, until July 1, for the installation of 35 electric street lamps, electricity to be supplied by a generator in its plant. For further information address R. S. Stanley, president.

DAMARISCOTTA, MAINE.—The Twin Village Water Company is contemplating enlarging its plant and extending its service. A holding company has been formed under the name of Portland Investment & Development Company with Col. H. M. Castner, of Portland, as president and E. E. Philbrook, of Damariscotta, treasurer. The company is capitalized at $100,000 and is negotiating for the property of the Centrifugal Leatherboard Company, which is in the hands of a receiver. If the new company acquires the property it will utilize power from the falls to generate electricity to operate lighting plant and pumps, and discard the present Deisel engine now in use. The company would also be able to supply electricity to the towns between Bath and Rockland and to furnish a 24-hour service.

LEWISTON, MAINE.—The Union Water Power Company has recently acquired control of certain privileges on the Androscoggin River, above Lewiston, owned by the International Paper Company, which are known as the Babbit and Googin dam and the Clark Rips privilege. It is estimated that 10,000 hp can be developed. Walter H. Sawyer is engineer.

LUBEC, MAINE.—The Lubec Sardine Company is rebuilding its plant, which was destroyed by fire in 1908. A power plant will be installed, the equipment of which will include one 85-kw, alternating-current generator; one 35-kw, alternating-current, three-phase generator for auxiliary purposes, both direct connected to engines. The electrical equipment will be installed by O. R. McKay, of Calais, Maine.

BALTIMORE, MD.—Henry J. C. Hoffman and others are interested in a project to build an electric railway between Brooklyn, a suburb of Baltimore, and Glenburnie, a distance of about five miles. The company will be known as the Brooklyn, Cedar Hill & Furnace Creek Electric Railway Company.

ATTLEBORO, MASS.—Application has been made to the Board of Selectmen to extend its street lighting system from the North Attleboro line to the Pawtucket line. It is said that there is no appropriation for the lamps this year, but that the question will be presented to the votors at some future meeting. With lamps in South Attleboro the entire distance between North Attleboro and Pawtucket will be lighted.

BOSTON, MASS.—The Edison Electric Illuminating Company has submitted a proposition to Guy Emerson, superintendent of streets, offering to install new tungsten street lamps throughout the city to replace the present gas and naptha lamps. Under the terms submitted, the city would save approximately $50,000 a year. If the contract should be awarded to the Edison Company, it would be necessary for the company to erect poles and wires to replace the present gas lamp posts.

CHICOPEE, MASS.—The residents of Willimansett have applied to the Board of Aldermen for electric lamps in that district. At present gas lamps are in use.

EASTHAMPTON, MASS.—The officials of the Connecticut River Power Company have notified the stockholders of the Easthampton Gas Company that they will exercise their option of the company's stock, for which they agree to pay $200 a share, par value $100. The company is capitalized at $50,000. The electrical plant will be connected with the Connecticut River plant at Turner's Falls.

EAST LEE, MASS.—It is reported that plans are being prepared for extensive improvements to the plant of the Mountain Mill Paper Company, at a cost of from $35,000 to $40,000, and will include the construction of a trunk and dam. A large generator is being installed to furnish electricity to operate the machines, all of which will be operated

by electric motors, except that which is on the main driving shaft. Turbines will replace the old overshot wheel.

PLYMOUTH, MASS.—Extensive improvements are being made to the power plant of the Plymouth Electric Light Company, which was badly damaged by fire a few weeks ago. A new 500-hp Harris-Corliss engine will replace the McIntosh-Seymour tandem, compound engine, and the 120 and 240-hp Ide engines in the old engine room will be discarded and other important changes made. The Plymouth Electric Light Company is using the temporary machinery in the power station of the Brockton & Plymouth Street Railway Company while repairs are being made to its plant.

SPENCER, MASS.—The Spencer Gas & Electric Light Company has been awarded the contract for lighting the streets of the town for five years commencing June 1, 1909. The company is to furnish 186 40-cp tungsten lamps at $17 each per year and 24 arc lamps of 1200-cp at $75 per lamp per year, making the total cost $4,962 per year.

CADILLAC, MICH.—The R. G. Peters Salt & Lumber Company and the farmers in the vicinity of East Lake and Hoxieville are constructing a new telephone line between the two places, a distance of 25 miles. The company will be known as the Hoxieville & East Lake Telephone Company.

DETROIT, MICH.—The Detroit Iron & Steel Company has placed an order with the Allis-Chalmers Company for a Reynolds-Corliss engine and a 250-kw direct-current generator.

EAST JORDAN, MICH.—The East Jordan Electric Light & Power Company contemplates improvements to its system, including a water power development and extensions to its transmission lines to meet the increasing demand for electricity for lamps and motors. W. A. Lovejoy is secretary.

GLADSTONE, MICH.—The Escanaba Electric Street Railway Company has been granted a 30-year franchise in Gladstone.

ST. LOUIS, MICH.—Arrangements are being made by the Union Telephone Company to install a complete metallic system in this city. The cost of the work is estimated at $20,000.

SUMNER, MICH.—The Sumner Rural Telephone Company contemplates extending its telephone lines to Riverdale to connect with the lines of the Union Telephone Company at that place.

AITKIN, MINN.—The Aitkin Telephone Company has commenced work on the construction of a telephone line to the new town of Cuyuna. The company will also transfer the Deerwood telephone line to new poles, which heretofore were strung on the railroad company's poles.

DEERWOOD,, MINN.—Plans are being considered by the Bay Lake Telephone Company to extend its telephone line on the west side of Bay Lake to connect with the Horace Mann system. It is said that the Aitkin Telephone Company will construct another telephone line into Deerwood.

FAIRMONT, MINN.—The Jay Center Telephone Company is planning to extend its telephone line to Dunnell.

MINNEAPOLIS, MINN.—Plans are being considered by Dr. P. M. Hall, health commissioner, to install a generator at the garbage crematory to furnish electricity for additional lamps in North Minneapolis. At present the crematory furnishes light, heat and power for the workhouse, Hopewell Hospital, and a number of other municipal buildings, saving the city about $8,000 a year. An appropriation of $5,000 will be asked for the purchase of a generator which will enable the plant to generate about 1000 hp. It is proposed to furnish electricity for 200 arc lamps in North Minneapolis, which would save the city about $15,000 per year.

MOTLEY, MINN.—The Laurel Telephone Company is making arrangements to build a telephone line about 10 miles in length.

NORTHFIELD, MINN.—Plans are being prepared by Edward P. Burch, engineer, Guaranty Building, Minneapolis, Minn., for a heating and lighting plant for the college, to cost about $30,000. Harlan W. Page is secretary and treasurer.

PAYNESVILLE, MINN.—Plans are being considered by the Village Council for extensions to the municipal electric light plant.

PINE RIVER, MINN.—The Pine River Rural Telephone Company will soon commence work on the installation of its local exchange and the erection of a telephone line to Emily.

WILLMAR, MINN.—An election will be held June 22 to vote on the proposition to purchase the local telephone exchange of the Northwestern Exchange Company. The value of the system is estimated at $35,000.

VICKSBURG, MISS.—Mayor Hayes has signed the contract between the City of Vicksburg and the Vicksburg Lighting Company for lighting the streets of the city for a term of five years. The contract calls for 150 arc lamps at $80 per lamp per year and 70 incandescent street lamps at $25 each per year with an all-night service. Under the old contract the lamps burned under the moonlight schedule.

COLUMBIA, MO.—Plans are being made by the Columbia Telephone Company to install a new central energy system and to place its wires in underground conduits, which will involve an expenditure of about $32,000.

ST. LOUIS, MO.—It is reported that the Kinloch Long-Distance Telephone Company will increase its capital stock from $3,000,000 to $5,000,000, the proceeds to be used for extension and development of the properties owned by the company as needed.

BUTTE, MONT.—It is reported that the Butte Electric & Power Company has acquired half of the capital stock of the Great Falls Water Power & Townsite Company, in which John D. Ryan and Thomas F. Cole are interested. The Great Falls Company has already constructed a hydro-electric plant of 8360 hp and is building a second plant which will develop 36,000 hp, and which will furnish electricity to the mines and smelters of the Amalgamated Copper Company. C. W. Wetmore, of New York, N. Y., is president of the Butte Electric & Power Company.

GREAT FALLS, MONT.—The Smith River & Castner Coulee Telephone Company, recently organized, is planning to construct telephone lines along the Missouri River to Flood and thence across the river to Truly. From Truly a branch will be erected to Castner Coulee and along the Smith River to Hound Creek. H. B. Ellis is president.

SPRINGDALE, MONT.—James A. Murray, of Butte, Mont., is reported to be interested in a project to construct an electric railway from Springdale to Hunter's Hot Springs, a distance of 2½ miles.

AINSWORTH, NEB.—Plans are being prepared by the Ainsworth Electric Light & Power Company for the construction of a dam across Plum Creek.

AINSWORTH, NEB.—Arrangements have been completed for installing an electric light plant in Ainsworth. Final surveys have been made for the construction of a dam across Plum Creek, 14 miles above Ainsworth, work on construction of which will commence immediately. It is estimated that 400 hp can be developed. A company has been incorporated to construct and operate the plant. The officers of the company are: F. W. Sellors, president; R. F. Osborn, vice-president; W. H. Williams, secretary, and R. S. Rising, treasurer.

BROKEN BOW, NEB.—Preparations are being made by John W. Early, of Columbus, Neb., for the installation of an electric light plant in Broken Bow. The equipment will include a four-valve or belted Corliss engine of 150 hp direct connected to a 100-kw, 2300-volt, three-phase generator.

SALMON FALLS, N. H.—The Berwick & Salmon Falls Electric Company has petitioned the Selectmen for permission to extend its transmission line from Rollinsford Junction to the Dover line and on other streets in the town.

JERSEY CITY, N. J.—Bids will be received by the New County Building Committee of the County of Hudson at its office, 373 Newark Avenue, Jersey City, N. J., until June 30 for furnishing and installing the electric lighting fixtures for the new county court house. Specifications for the work may be procured from Hugh Roberts, architect, 1 Exchange Place, Jersey City, N. J., or at the office of the committee. Frederick Rippe is president of the committee.

CARTHAGE, N. M.—Plans are being prepared by the Carthage Coal Company for an electric power plant to supply electricity to its own and surrounding properties.

GENEVA, N. Y.—The Rochester & Eastern Rapid Railway Company is contemplating extending its railway from Geneva to Penn Yan.

MEDINA, N. Y.—The Public Service Commission, Second District, has refused the application of S. Cook & Company to construct and operate an electric and steam heating plant in Medina. The granting of the franchise was opposed by the A. L. Swett Electric Light & Power Company, which now furnishes electricity in Medina. Setley A. Cook, D. J. Bigelow and others are interested in the Cook company.

NEW BALTIMORE, N. Y.—The Town Board of New Baltimore, it is stated, is ready to receive bids for lighting the streets of the town.

NEW YORK, N. Y.—Plans are being made to replace 600 of the old-style gasoline lamps in Central Park with 1490 electric lamps. The installation of the new lamps will call for an expenditure of about $32,000.

NEW YORK, N. Y.—Bids will be received by C. B. J. Snyder, superintendent of school buildings, Department of Education, Park Avenue and Fifty-ninth Street, New York, N. Y., until June 21 for installing electric equipment in new Public School 101, located on East 111th Street, near Lexington Avenue.

NEW YORK, N. Y.—The Public Service Commission has refused to approve the franchise of the South Shore Traction Company granted by the Board of Estimate and Apportionment permitting the company to construct an electric railway from Jamaica to and across the Queensboro Bridge. The commission explains its refusal on the ground that the franchise would give the company absolute control of Thomson Avenue and Hoffman Boulevard, two of the most important highways in Queens.

NYACK, N. Y.—The Public Service Commission has granted the Rockland Railroad Company permission to construct and operate its railway in Rockland County and to exercise franchises in the villages of Grand-View-on-Hudson, Nyack, South Nyack, Haverstraw, West Haverstraw, Spring Valley and Suffern, and in the towns of Clarkstown, Stony Point, Orangetown and Ramapo. The company has also received a franchise from the Board of County Supervisors. At the present time there are no electric railways in Rockland County.

PAINTED POST, N. Y.—The citizens are considering the question of establishing a municipal electric light plant.

ROCHESTER, N. Y.—The Rochester Railway & Light Company has entered into a contract to supply electricity for operating the system of the Rochester, Charlotte & Manitou Beach Railway Company.

SMITHTOWN, N. Y.—The North Shore Electric Light & Power Company, of Port Jefferson, N. Y., has applied for a franchise to furnish electrical service in Smithtown.

SYRACUSE, N. Y.—The Syracuse, Lake Shore & Northern Electric Railroad Company is erecting a feed wire from its power house at Lakeland to the substation near Phoenix, which will supply the additional energy necessary for the operation of the new Lake Shore cars, and also

for the proposed extension of the railway from Fulton to Oswego, when completed. Electricity will be supplied from the company's plant and also from the transmission lines of the Niagara Power Company.

UTICA, N. Y.—The Utica Gas & Electric Company has submitted a proposition to the special committee of the Board of Supervisors appointed to investigate the question of installing a plant to light the county buildings, offering to supply electricity for lighting the court house, armory and jail at a reduction of about 40 per cent from the present price, which is 10 cents per kw-hour. It is said that the committee will recommend the Board of Supervisors to accept the offer and lay aside the proposition to install an electric plant for the present. According to the report of the committee it would cost the county $27,000 to install the plant. It is estimated that the plant would furnish the service for 5 cents per kw-hour, which the Utica company now offers to furnish at 6 cents.

ANSONVILLE, N. C.—A. H. Richardson, of Ansonville, writes that he has completed surveys for a water power project near Wharftown, where from 5000 to 6000 hp can be developed in the heart of the Piedmont section of the manufacturing district of the south. He states that he would take stock in a large cotton mill to locate there or sell his rights. A. S. Lyman, of Filesville, N. C., is engineer.

ASHEVILLE, N. C.—Plans are being made by the Asheville Telephone & Telegraph Company for improvements to its system, which will include the erection of a copper metallic circuit from Asheville to Morganton by the way of Marion to connect with circuit running to New Orleans, La. The cost of the work is estimated at $7,400.

KERNERSVILLE, N. C.—The Kernersville Light & Power Company, which was recently granted a 25-year franchise to establish an electric light plant, it is reported, will erect a power plant which will be equipped with boilers of 100 hp, a 75-hp engine and a 50-kw, 2300-volt, three-phase generator. C. S. Swann, of Kinston-Salem, N. C., is engineer in charge of the work.

MONROE, N. C.—The town has voted to issue $20,000 in bonds to fund a debt on the municipal electric light plant, and to meet the financial requirements of an agreement with the Southern Power Company, which is extending its transmission lines to Monroe from its hydro-electric developments along the Catawba River in South Carolina. The Southern Power Company is now ready to furnish electricity for lighting the town and for manufacturing purposes. Several large private contracts have already been secured by the company.

NEW BERN, N. C.—A franchise to operate a local street railway system has been granted to R. P. Foster and R. A. Nunn for a period of 30 years. A company has been chartered under the name of the New Bern Power Company, with an authorized capital of $500,000, to construct and operate the railway.

SALISBURY, N. C.—An electric railway franchise has been granted to a syndicate to build a 5 or 10-mile line to Granite Quarry, Faith and nearby points, reaching the large granite quarries of Rowan County, North Carolina.

YANCEYVILLE, N. C.—This town is negotiating with the Burgrahaw Traction Company with a view of persuading the company to extend its plans so as to include an electric railway to this point, through Caswell County, from Burlington and Graham, N. C. J. H. Harden is secretary of the traction company.

ALMONT, N. D.—Hiram S. Goff is interested in a project to construct a telephone line to Carson.

FARGO, N. D.—The State Supreme Court has declared the $100,000-bond issue voted by the city for the purpose of installing an electric light plant and water-works system illegal, reversing the findings of the county court.

GLENBURN, N. D.—Preparations are being made by the Lone Star Telephone Company for the erection of about 20 miles of rural telephone lines.

GRAND FORKS, N. D.—The City Council has adopted a resolution to employ an engineer to prepare plans and specifications for installing an improved system of lighting the business portion of the city.

TOLNA, N. D.—Arrangements are being made by the Cheyenne Telephone Company for extending its telephone line from Mapes into Lakota, which will require the erection of about 20 miles of wires, contracts for which, it is said, will soon be let.

VALLEY CITY, N. D.—The contract for installing a central steam heating and lighting plant for the normal school was awarded to the Andrews Heating Company, of Minneapolis, Minn., for $26,000. G. McFarland is president state normal school.

WAHPETON, N. D.—F. L. Strum has applied to the City Council for a franchise to construct a street railway in Wahpeton, which will be extended to Breckenridge. Mr. Strum has also applied to the Council in Breckenridge for a franchise.

WILLISTON, N. D.—Plans are being considered by J. J. Delaney and H. C. McCartney for extensions and new equipment to their local exchange which will involve an expenditure of about $40,000.

CANTON, OHIO.—The City Council has appointed a committee to investigate the question of installing a municipal electric light plant in connection with the water-works.

CLEVES, OHIO.—The contract for lighting the streets of the village has been awarded to P. M. Hans for a term of ten years. Arc lamps of 2000 cp are to be furnished at $60 per lamp per year.

COLUMBUS, OHIO.—The Columbus, New Albany & Johnstown Traction Company has awarded the contract for the extension of its railway from its present terminus at Gahanna to Johnstown, a distance of 14 miles, to the Dominion Construction Company, of Pittsburgh. An appropriation of $050,000 has been made to cover the cost of the work.

DAYTON, OHIO.—Sealed proposals will be received at the office of W. A. Budroe, clerk of the Board of Public Service until June 24 for one direct connected engine and generator rated at 40 kw. The engine to be side crank type, the cylinder 10 in. in diameter, 12 in. stroke working at 100 lb. pressure not exceeding 300 r. p. m. to develop 65 hp. Bidders must use printed forms provided by the Department of Water. J. C. Ely is president of the Board of Public Service.

KENTON, OHIO.—The Kenton Gas & Electric Company is planning to change its plant from 125 cycles to 60 cycles and also making other improvements with a view of furnishing electricity for motors as well as for lamps. The cost of the work is estimated at $20,000.

YOUNGSTOWN, OHIO.—The Youngstown Sheet & Tube Company has awarded the contract for the installation of eight large electric traveling cranes to the Morgan Engineering Company, of Alliance, Ohio, at an approximate cost of $50,000.

YOUNGSTOWN, OHIO.—The Lake Erie & Youngstown Railway Company has awarded the contract for its proposed electric railway, to extend from Conneaut through Andover and other points to Youngstown, to the Stanley Construction Company. The cost of construction and equipment of the road is estimated at $3,000,000.

ARDMORE, OKLA.—The proposition recently submitted by Oscar Ayers to the citizens of Ardmore for the construction of an electric interurban electric railway from Ardmore to Chickasha has been accepted and work on a preliminary survey of the route will begin at once. The terms include a bonus of $50,000 and a right-of-way from Ardmore to Springer, a distance of 12 miles.

CHICKASHA, OKLA.—The City Council has granted Lawrence Martin a 25-year franchise to construct and operate a street railway in Chickasha, subject to the vote of the people.

HOBART, OKLA.—The Oklahoma Midland Electric Railway Company has awarded the contract for the construction of its proposed electric railway, which is to extend from Sayre to Oklahoma City, via Hobart, a distance of 150 miles, to the J. A. Kauffman Company, of La Fayette, Ga. The contract also includes the construction of two 8000-hp hydro-electric plants.

JEFFERSON, OKLA.—The Jefferson Power & Light Company, recently incorporated, contemplates the construction of a hydro-electric plant at a cost of from $125,000 to $150,000. D. E. McNeff, of Jefferson, is president, and W. T. Croslen, of Chicksha, Okla., is engineer.

PORTLAND, ORE.—The stockholders of the Portland Railway, Light & Power Company have authorized an expenditure of more than $6,000,000 for extensions to its system. The work will include the construction of a new 30,000-kw power plant on the Clackamas River, three miles above the site of the present plant, which will cost ultimately $2,500,000. Actual work on construction of the plant will begin next year. Preliminary to the construction of the plant the Cazadero line will be extended to the site for transportation of material for the plant. The dam will be 160 ft. high and 450 ft. wide, and will be of solid concrete construction. A new steam plant is also to be erected on the east side near the Inman-Poulsen property at a cost of $400,000, which will be used as an auxiliary plant. The rest of the work contemplated by the company includes the construction of underground conduits at a cost of $1,250,000; new substations at Seventh and Adler Streets and at other locations and extension to its railway lines, some of which are already commenced.

PANAMA.—Bids will be received until June 22 at the office of the general purchasing officer, Isthmian Canal Commission, Washington, D. C., for furnishing electrical supplies, including fixtures, fittings, lamps, cable, wire, line material, sheet copper, hardware, cross-arms, solder, tape, etc., according to Circular No. 517. Blanks and general information pertaining to the above circular may be obtained from the office of the general purchasing officer or the offices of the assistant purchasing agents, 24 State Street, New York, N. Y.; 316 Hibernia Bank Building, New Orleans, La., and 1086 North Point Street, San Francisco, Cal.

ALLENTOWN, PA.—Bids will be received by J. S. Troxell, chief clerk, of the Board of County Commissioners of Lehigh County, Court House, Allentown, Pa., until June 23 for the construction of an electric light and power plant at the County Home at Wescoesville, Pa., as follows: (1) For furnishing and erecting two 150-hp boilers, 150 lb. pressure of the water tube or combination water tube and return tubular type. (2) For one 40-hp, horizontal, single cylinder, direct connected, high speed, automatic cut-off, non-condensing engine. (3) For one 80-hp, horizontal, single cylinder, direct connected, high speed, automatic cut-off, non-condensing engine. (4) For one 250-hp feed water heater. (5) Two feed water pumps. (6) For one 25-kw generator. (7) One 45-kw generator. (8) For furnishing and erecting all steam piping, stack connections, separators and valves, inside and outside wiring, switchboards, pole lines, lamps and fixtures and all necessary appurtenances and appliances for a complete electric plant. The power house and foundations will be furnished by the county. Plans and specifications may be examined at the office of the County Commissioners or copies may be secured from them by depositing the sum of $25 with the clerk, which will be returned to the depositor if he presents a bid for the work. If no bid is submitted the deposit will be retained by the county.

BIRDSBORO, PA.—The capital stock of the Conestoga Telephone Company has been increased from $15,000 to $40,000.

DUNMORE, PA.—The promoters of the proposed electric railway between this city and Lake Ariel have applied to the Borough Council for a franchise over certain streets in Dunmore to connect with the Scranton Railway Company's line. W. L. Connell, Valentine Bliss and A. G. Rutherford are interested in the enterprise.

HARRISBURG, PA.—Plans are being considered by the Central Pennsylvania Traction Company for several extensions to its system, which will include the construction of a railway to Dauphin and car barns.

HAZLETON, PA.—The Harwood Power Company is making arrangements to extend its transmission lines to Berwick, where it will furnish electricity for lamps and motors in the territory served by the companies recently consolidated. The company will enclose its wires in aluminum cables. The cost of the line is estimated at about $25,000. The company has entered into a contract with the Berwick Car Works to supply electricity to operate its plant, to replace steam power now in use.

HILLSDALE, PA.—The capital stock of the Hillsdale Western Telephone Company has been increased from $2,000 to $5,000.

JOHNSTOWN, PA.—The Johnstown & Gallitzin Railway Company, it is said, will award contracts in August for steam power equipment for its plant to be located near St. Michaels, which will be equipped with two units of 750 kw each.

KUTZTOWN, PA.—The Kutztown Rural Telephone Company is erecting a telephone line from Krumsville to New Smithville, and is planning to extend the line to Lenhartsville and later to Hamburg.

MEDIA, PA.—The stockholders of the Citizens' Electric Light & Power Company, of Clifton Heights; the Faraday Heat, Power & Light Company, of Morton; the Philadelphia Suburban Electric Light Company and the Media Electric Light, Heat & Power Company, of Media, will vote June 21 on the adoption or rejection of an agreement for the merger and consolidation of the companies. If the various companies agree to the merger, the International Gas & Electric Company will assume control of the properties. It is said that a large plant will be constructed in the central section of the county to serve the territory covered by the various companies. W. Roger Fronefield, of Media, and Harry Rhodes, president of the Media Title & Trust Company, are interested in the enterprise.

PHILADELPHIA, PA.—Proposals will be received at the Bureau of Yards and Docks, Navy Department, Washington, D. C., until July 10 (an extension of date from June 26) for motor-generator sets, exciters, switchboard, etc., at the navy yard, Philadelphia, Pa. Specifications can be obtained on application to the bureau or to the commandant of the navy yard named. R. C. Hollyday is chief of bureau.

PITTSBURG, PA.—The public works committee of the Councils have recommended the following measures: Authorizing the contracts for purchase and installation at the Southside pumping station of a traveling electric crane to cost $4,000; boilers and stokers, at $20,000; two pumping engines, at $180,000; electric light plant, $4,000, and pumping station, $70,000.

WINDBER, PA.—The Berwind-White Coal Mining Company, it is stated, will install additional motors, transformers, etc., in its mines and yards this summer.

LAKE PRESTON, S. D.—The Lake Preston Milling Company is planning to install a 50-kw generator in connection with its flour mill to furnish electricity for lamps in the city. The company was recently granted a franchise by the City Council.

LITTLE BEND, S. D.—A company has been organized to erect a telephone line to connect Little Bend with Onida, the county seat, a distance of 30 miles. H. P. Knox, of Little Rock, is president; W. E. Jenkins, of Okobojo, secretary, and M. L. French, of Onida, treasurer, of the company.

PIERRE, S. D.—Bids will be received by the State Capitol Commission until July 28 for furnishing and installing electric fixtures in the new capitol. C. E. Pell is architect and Governor R. S. Vessey, chairman state capitol commission.

TYNDALL, S. D.—It is reported that negotiations are under way for the purchase of the local electric light plant by the city. If the deal goes through, the city will install a larger engine in connection with the water works, which will furnish power to operate the lighting system.

CHATTANOOGA, TENN.—Mayor Crabtree has vetoed the ordinance granting C. E. James and others an extension of 18 months' time in which to begin work on the erection of its transmission lines on the streets of the city for the distribution of electricity for lamps and motors. The time limit expires June 19.

MEMPHIS, TENN.—The contract for lighting the new Shelby County court house has been awarded to the Merchants' Light & Power Company at a cost of $6,570.

AMARILLO, TEX.—Plans are bing considered by C. F. Hacker to establish a glove factory, which will be operated by electricity.

CLIFTON, TEX.—The new electric power plant will soon be placed in operation. It is an auxiliary to the plant now in use and will insure a 24-hour service.

ORANGE, TEX.—Arrangements have been completed by the Yellow Pine Paper Company for enlarging its plant, which will involve an expenditure of about $200,000. An electric power plant will be installed to furnish electricity to operate the works.

FORT DOUGLAS, UTAH.—Bids will be received at the office of the chief quartermaster, Denver, Col., until July 6 for furnishing electricity at Fort Douglas, Utah, for illuminating and small motor purposes. Distributing system will be ready for electrical energy about Jan. 1, 1910. Information will be furnished on application to this office or to the post quartermaster. J. W. Pope is chief quartermaster.

SALT LAKE CITY, UTAH.—We are informed that the Salt Lake & Ogden Railway Company contemplates placing contracts during the next five months for the construction of a 2500-kw power station and equipment for the same.

CHARLES CITY COURTHOUSE, VA.—The Charles City Telephone Company is planning to extend its telephone line from Roxbury to Bradley's Store and thence to Granville. The new line will be built this summer.

FRIDAY HARBOR, WASH.—The Pacific Electric Company, of Port Townsend, Wash., has applied to the City Council for a franchise to furnish electricity for lamps in Friday Harbor.

HANFORD, WASH.—The Hanford Irrigation & Power Company has awarded the contract for machinery and equipment for its electric substation and water works system in Hanford to the Allis-Chalmers Company, of Milwaukee, Wis. Electricity for operating the system will be transmitted from its plant at Priest Rapids. The water works pump will be operated by an electric motor.

WALLA WALLA, WASH.—Plans are being prepared by the North Western Gas & Electric Company for the construction of a new power plant and substation, at a cost of $100,000, and a new office building to cost $30,000.

FAYETTEVILLE, W. VA.—R. H. Dickinson has applied to the City Council for a franchise to construct and operate an electric light system and street railway from Fayetteville to Stuart, connecting with the White Oak Railway.

OAK HILL, W. VA.—Application has been made to the city by J. P. Staton for a franchise to construct and operate an electric light and power plant in Oak Hill. M. Van Pelt is mayor.

FOREST JUNCTION, WIS.—The Forest Junction Telephone Company has awarded a contract to the Fox River Valley Telephone Company for the erection of eight miles of telephone line through Dundas and Holland to connect with the Wrightson exchange.

NEWTON, WIS.—The English Lake Telephone Company has increased its capital stock from $21,000 to $42,000.

CLARESHOLM, ALTA., CAN.—Plans are being considered for the construction of a municipal electric light plant and water-works system. At an election held recently the citizens voted to issue $76,000 in bonds to pay for the same. P. Turner Bone, of Calgary, is engineer.

WINNIPEG, MAN., CAN.—The Provincial Government has purchased the telephone system from the Municipality of Turtle Mountain, the latter finding it could not operate the system as satisfactorily as the government.

BURLINGTON, ONT., CAN.—Bids will be received until June 21 by the city clerk for construction of water works system as follows: Contract B—Pump house. Contract C—Electrically operated pumping machinery. Contract I—Steel pump well. Plans and specifications may be seen at Burlington, or at the office of Willis Chipman, chief engineer, 103 Bay Street, Toronto, Ont. O. T. Smith is secretary.

HAMILTON, ONT., CAN.—At an election held June 6 the citizens voted for the third time in favor of the Hydro-Electric Power Commission's scheme, rejecting the proposition of the Cataract Power Company.

INGERSOLL, ONT., CAN.—The Ingersoll Electric Light & Power Company has refused an offer of $35,000 for its plant made by the City Council.

NIAGARA FALLS, ONT.—Contracts have been signed for the equipment and machinery for the 12 transformer stations of the Hydro-Electric Power Commission transmission belonging to the province, which will involve an expenditure of about $1,000,000.

ST. CATHERINES, ONT., CAN.—The Niagara, St. Catherines & Toronto Railway Company is reported to have agreed to extend its railway from Welland to Port Colburne, provided satisfactory terms can be made with Port Colburne. It is expected that the railway will eventually be extended along the shore of Lake Erie from Port Colburne to Buffalo.

TORONTO, ONT., CAN.—The citizens on June 7 voted in favor of the by-law appropriating $466,000 to provide electrical pumps and extensions of water mains into the newly annexed districts.

TORONTO, ONT., CAN.—The contract for the materials and equipment for the transformer station and engines has been awarded to the Westinghouse Company, of Hamilton, Ont., and the General Electric Company of Peterboro, Ont.

WELLANDPORT, ONT., CAN.—H. Lloyd, of Dunville, has been awarded the contract for the construction of the first 10 miles of the proposed electric railway of the Dunville, Wellandport & Beamsville Railway Company. The railway when completed will be about 23 miles in length. James A. Ross, of Wellandport, is president.

WHITBY, ONT., CAN.—The Town of Whitby is advertising for bids for $16,000 water works and electric light debentures, approved by the Ontario Railway and Municipal Board.

DRINKWATER, SASK., CAN.—Sealed tenders will be received for the construction of a telephone system for the Golden Flat Telephone

Company. All materials are supplied excepting poles. The estimated length of the line is 21 miles.

MOOSEJAW, SASK., CAN.—The Saskatchewan Government has purchased the plant, franchises, equipment, lines, etc., of the Saskatchewan Telephone Company, with headquarters in Moosejaw, for a consideration of $150,000. The system includes exchanges at Moosejaw, Rouleau and Estevan, with 275 miles of long-distance line. This gives the Province complete control of virtually all the telephone lines in Saskatchewan.

PRINCE ALBERT, SASK., CAN.—The Board of Trade has written a suggestion to the Dominion Government that the proposed railway to Hudson's Bay be operated by electricity developed from the water powers to the north of Prince Albert.

New Industrial Companies.

THE EAST COAST EQUIPMENT & CONSTRUCTION COMPANY, of New York, N. Y., has been chartered with a capital stock of $50,000 to do a general contracting business. The incorporators are: Leo W. Wertheimer, Edward C. Mulligan and Fred Cook, of New York, N. Y.

THE ELECTRO-CHEMICAL PULP & PAPER COMPANY, of Auburn, Maine, has filed articles of incorporation with a capital stock of $500,000 to handle patents and patent rights. W. H. Oakes is president; E. M. Hatch, treasurer, and F. R. Ludden, clerk, all of Auburn, Maine.

THE ENGINEERING SUPPLY & ERECTION COMPANY, of New York, N. Y., has been incorporated with a capital stock of $3,000 to manufacture and deal in contractors' supplies. The incorporators are: Graham B. Moore, Benjamin L. Shafer and John T. Reilley, all of New York, N. Y.

THE EUROPEAN REGENERATOR COMPANY, of New York, N. Y., has been chartered with a capital stock of $5,000 to manufacture steam regenerators or accumulators by Charles A. Wendell, Lucius Varney, of New York, N. Y., and Signono C. Munoz, of Montclair, N. J.

THE JEWEL ENGINEERING COMPANY, of Paterson, N. J., has been incorporated with a capital stock of $50,000 by Edmund Whitaker, of Haledon, N. J.; Edward Livingstone, Frederick W. Johnson and George A. Fischer, all of Paterson, N. J. The company proposes to carry on a mechanical and electrical engineering business, tool making, etc.

THE NORTHWESTERN BATTERY COMPANY, of Winnipeg, Man., Can., has been incorporated, with a capital of $200,000. A. K. Dysart, of Winnipeg, is attorney.

THE UNION LIGHT COMPANY, of New York, N. Y., has been incorporated with a capital stock of $10,000 by Augustus S. Houghton, of Greenwich, Conn.; Glenn S. Williamson, Henry Houghton, of New York, N. Y. The company proposes to manufacture lamps, burners, mantels, chimneys, etc.

THE UNITED ELECTRIC LAMP COMPANY, of New York, N. Y., has filed articles of incorporation with a capital stock of $10,000 for the purpose of doing electrical work of all kinds. The incorporators are: B. P. Heide, of Brooklyn, N. Y.; O. A. Heide and A. Lotz, both of New York, N. Y.

THE WABASH ELECTRIC COMPANY, of Chicago, Ill., has been incorporated with a capital stock of $10,000 to manufacture electrical fixtures and appliances by O. L. McCaskill, of Chicago, Ill.

New Incorporations.

GARLAND, ARK.—Articles of incorporation have been filed for the Garland Power & Development Company with a capital stock of $1,500,000 to construct a hydro-electric plant across the Ouchatita River. The officers of the company are: Henry Dalhoff, of Little Rock, Ark., president; P. J. Harmon, vice-president; J. A. Stalcup, treasurer. Parrett & Beard, Dwight Building, Kansas City, Mo., are the engineers.

REDWOOD CITY, CAL.—Articles of incorporation have been filed for the Sierra & San Francisco Power Company with a capital stock of $20,000 for the purpose of dealing in water rights and electricity by J. S. Thornton, of Sonoma; Winfield Dorr, of Oakland; H. J. P. Jackson, of Berkeley; George H. Whipple, of San Francisco, Cal., and Warren Gregory, of Berkeley. It is said that the company has been formed for the merger of the Stanislaus Electric Power Company with the United Railways Investment Company, of San Francisco.

SAN FRANCISCO, CAL.—Articles of incorporation have been filed for the Win Power Company with a capital stock of $499,800 and the following-named directors: J. M. Agar, Ferdinand Butterfield and W. A. Lotspeich. The company proposes to deal in electricity, gas and water power.

SAN FRANCISCO, CAL.—The Municipal Light & Power Company has been incorporated with a capital stock of $1,000,000 by Rudolph Spreckels, Claus A. Spreckels, Percival S. Scales, J. H. Sanford and Frank Harold. The company proposes to furnish electricity and gas and to purchase and install gas and electric plants.

SAN FRANCISCO, CAL.—The Fresno Power Company has filed articles of incorporation with a capital stock of $1,000,000, for the purpose of doing a general power, lighting and irrigating business. The directors are: George A. Knight, J. M. Ough, A. M. Wooley, Charles J. Heggerty, William H. Madden, all of San Francisco.

WINCHESTER, CAL.—The Winchester Pleasant Valley Telephone Company has been chartered to construct and operate local rural telephone lines to connect with the Home and Sunset Telephone companies' long-distance service. M. L. Howell is president and C. W. Patterson is secretary.

MACON, GA.—The Georgia Lighting Company has been chartered with a capital stock of $10,000. A. J. Smith is at the head of the enterprise.

OLIVER, GA.—The Farmers' Telephone Company has been organized to construct local telephone lines. The officers of the company are: R. D. Farr, president; O. H. Marsh, vice-president, and H. E. Ezell, secretary and treasurer.

COLUMBIA, ILL.—The Cahokia Telephone Company has been incorporated with a capital stock of $2,400 by C. R. Harris, E. B. Rauch and A. C. Bollinger.

MODESTO, ILL.—The Modesto Telephone Company has been incorporated with a capital stock of $7,000, by Augustus Zetmer, R. L. Corrie and C. Van Winkle.

NEW MINDEN, ILL.—The New Minden Mutual Telephone Company has been chartered with a capital stock of $2,400 by H. W. Meinert, C. G. Rinne and W. C. Colimeyer.

PORT BYRON, ILL.—The Port Byron Telephone Company has been incorporated, with a capital stock of $2,500, by A. Saddoris, W. H. Groth and Samuel L. Woodburn. The company proposes to construct and operate telephone lines in Rock Island and other parts of the state.

EVANSVILLE, IND.—It is reported that the stock of the Evansville Lighting Company, a $3,000,000 corporation which owns the Evansville Gas & Electric Light Company, is being bought up preparatory to a merger to include the Evansville Light Company, the Springfield (Ill.) Railway & Light Company, the Rockford (Ill.) Railway & Light Company and the Peoria (Ill.) Light Company. A new company, to be known as the Union Railway, Gas & Power Company, has been formed to take over the properties. The new concern proposes to issue $8,000,000 in bonds and preferred stock and $6,000,000 in common stock.

INDIANAPOLIS, IND.—Articles of incorporation have been filed for the Indiana Union Telephone & Telegraph Company by F. A. De Peyster, C. A. McNaughton and D. F. Williams. The company is capitalized at $100,000, and proposes to construct and operate a telephone line in Benton, Warren, White, Jasper, Newton, Lake, Porter and other counties.

PLYMOUTH, IND.—The Plymouth Mutual Telephone Company has been chartered with a capital stock of $2,000 by A. T. Bartell, R. L. Cloud and S. H. Aldridge.

SULLIVAN, IND.—By order of Judge Anderson, of the Federal Court, the plant of the Sullivan Lighting Company will be sold at public sale at the Courthouse July 1. The plant is valued at $100,000, and is in the hands of the Marion Trust Company, of Indianapolis, as receiver.

WASHINGTON, IND.—The Farmers' Washington Township Telephone Company has been incorporated to build and operate a telephone system in Washington Township and throughout Allen County. J. Oswald, William E. Miner and John Kariger are directors.

LELAND, IA.—The Leland Mutual Telephone Company has filed articles of incorporation with a capital stock of $5,000. The officers of the company are: E. E. Branstad, president; O. Michaelson, vice-president; E. G. McGreevey, secretary, and W. P. Buren, treasurer.

WATERLOO, IA.—The Big Rock Telephone Company has been incorporated with a capital stock of $1,000 and the following named officers: J. T. Allen, president; and E. E. Sage, secretary. The business address of the company is Waterloo, R. F. D., No. 3.

KANSAS CITY, MO.—Articles of incorporation have been filed for the Kansas City, Lawrence & Topeka Electric Railway Company for the purpose of constructing an electric or steam railway between Topeka and Kansas City, a distance of 67 miles. The company is capitalized at $1,000,000, and it is stated that it proposes to take over the Kansas City-Olathe Railway, now in operation. The incorporators are: P. W. Hocker, F. P. Dickson, J. A. Stewart, F. B. Glover, of Kansas City, Mo.; D. B. Johnson and R. O. Larson and George Holsinger, of Rosedale.

CHINOOK, MONT.—The Co-operative Telephone Company has been incorporated with a capital stock of $40,000 to construct a telephone system from Chinook to Paradise Valley. The incorporators are: Rudolph Hermes, John Brummer, James N. Cook, W. D. Smotherman and R. L. Morris.

THOMPSON, MONT.—Articles of incorporation have been filed for the Western Montana Telephone Company with a capital stock of $12,500 by A. S. Ainsworth and others.

DORSEY, NEB.—The Dorsey Telephone Company has been chartered with a capital stock of $3,000 by D. D. Miles, William Carlson, John T. Brady and others.

PAWLING, N. Y.—The Pawling Electric Light, Heat & Power Company has filed articles of incorporation with a capital stock of $20,000 for the purpose of furnishing electricity for lamps and motors in the towns of Pawling, Dover and Patterson. The directors are George W. Chase, Frederick L. Gamage, John G. Dutcher, Charles E. Baker, Henry A. Holmes and others, all of Pawling, N. Y.

BISMARCK, N. D.—The Rosebud & Youngstown Telephone Company has been formed to construct a telephone line to connect with the North Dakota Independent Telephone Company's line at New Salem. About 30 miles of wire will be erected, material for which has been purchased.

Robert Rusch is president, John Holle, secretary, and Charles Klusman, treasurer.

FLORENCE, OKLA.—The Boone Telephone Company has been chartered by C. E. McIntosh, A. P. Sparks and T. R. Effiatt.

FT. COBB, OKLA.—The South Side Mutual Telephone Company has been chartered with a capital stock of $1,000, by Stephen P. Ratcliff, William L. Keever and J. A. Campbell, all of Fort Cobb.

OKLAHOMA CITY, OKLA.—The Crutcho Telephone Company has been incorporated with a capital stock of $600 by E. A. Wagner, L. M. Warner and G. B. Alguire.

Personal.

PROF. C. E. BRACKETT has resigned as director of the School of Electrical Engineering of Princeton University.

MR. ROBERT HAMILTON has been appointed Dominion of Canada inspector of electricity and gas for the Winnipeg district, with headquarters at Winnipeg, Man., Can.

MR. R. W. CLARK, of the Minneapolis General Electric Company, recently gave a lecture before the electrical engineering students of the University of Michigan upon "Home Lighting."

MR. FREDERICK DARLINGTON will deliver an illustrated lecture on "Electrification of Railroads" at the meeting in Harrisburg, Pa., this week of the Engineers' Society of Pennsylvania.

MR. P. McNIVEN BINNIS will present a paper on the "Relation of Electric Furnaces to Siderurgy" at the meeting this week in Harrisburg, Pa., of the Engineers' Society of Pennsylvania.

MR. H. C. SLEMIN, sales and advertising manager of the Stromberg-Carlson Company, was married June 9, at Rochester, N. Y. to Miss Rosa Emma, daughter of Mr. and Mrs. Gustav Erbe.

MR. V. D. MOODY, of Hamner & Moody, 25 Broad Street, New York, has left for Mexico City in connection with the interests of Dr. F. S. Pearson, comprising The Mexican Light & Power Company and The Mexican Tramway Company.

MR. E. J. BERG.—At the commencement exercises at Union College, Schenectady, N. Y., on June 9, among the honorary degrees conferred was that of Doctor of Science on Mr. E. J. Berg, electrical engineer of the General Electric Company.

MR. SHIGERU KONDO, electrical engineer to the Japanese Department of Communications, and who represented Japan at the recent meeting in London of the Electro-technical Commission, is spending some weeks in this country prior to sailing for home.

MR. GEO. W. CRAVENS, consulting engineer, Chicago, Ill., has removed his office to the First National Bank Building, where he will have larger quarters. He reports his business as increasing, especially along the line of power plant promotion, design, appraisal and betterments.

MR. SAMUEL D. FOWLER, for many years designing engineer for the Sterling Electric Company, of Lafayette, Ind., has resigned his connection with that company. Mr. Fowler has invented three different common battery systems which are noted for their simplicity and practicability, and has also been active in other lines of electric design.

BENJAMIN-DOREMUS.—On June 9, in New York City, Miss Katherine W. Doremus, daughter of Dr. and Mrs. C. A. Doremus and granddaughter of the late Prof. R. O. Doremus, was married to Park Benjamin, Jr., son of Mr. Park Benjamin, the patent expert, and grandson of the well-known author of the same name. On both sides the happy pair are widely acquainted in the electrical field.

Obituary.

MR. JEFFERSON D. KEARNEY, of Chicago, whose serious illness was mentioned recently in this paper, died on June 2. The cause of death was tuberculosis of the lungs. Mr. Kearney was formerly connected with the Central Electric Company and the Zenco Electric Supply Company, of Chicago, and more recently he acted as a manufacturers' agent. He had many friends among the electrical men of the West, and his death at a comparatively early age is sincerely regretted by all who knew him.

MR. M. D. BARR died suddenly from heart failure in Sandusky, Ohio, on May 29. Mr. Barr had been connected with the electrical industry for the past 25 years, beginning in Canada as M. D. Barr & Company. About 15 years ago he joined the Stanley Electric Mfg. Company of Pittsfield, Mass., as manager of its New York office, and subsequently general sales manager. When the Stanley Company was acquired by the General Electric Company, Mr. Barr was made vice-president. In 1906, when the General Electric Company decided to discontinue the commercial department of the Stanley Electric Mfg. Company, and the Pittsfield factory became the Pittsfield works of the General Electric Company, Mr. Barr withdrew and engaged for a time in the exploitation of street railway properties in New England. A year or more ago, when the creditors of the Warren Electric Mfg. Company, of Sandusky, Ohio, were looking about for someone to manage that property, Mr. Barr was selected and made general manager of that company. When some months later it was finally determined that bankruptcy for this concern was inevitable, Mr. Barr was appointed first trustee for the bondholders, and in February of this year he was made special master of the property by the local Common Pleas Court. He had been engaged since that time in winding up its affairs. Mr. Barr had numerous friends in the electrical industry, especially in Toronto, New York, Pittsfield and Boston. His home was in Spencer, Mass., in which place his remains were interred on June 2.

Trade Publications.

GRAPHITED GREASES.—A new folder issued by the International Acheson-Graphite Company is devoted to Graphited Greases, products which are designed for gear, cup and ball-bearing use. In the manufacture of its graphited greases, this company uses the world's purest and best graphite, which is a perfect lubricant in itself. The graphite and grease are thoroughly blended, and it is claimed that the resultant product will do far more work than any other grease product on the market, great value being given the combination by the superior lubricating qualities of the graphite.

PORCELAIN POTHEADS.—The C. & W. Electric Specialty Company, 128 West Jackson Boulevard, Chicago, describes its various products in a recent issue of bulletins. These porcelain potheads are made in a great variety of forms for the connection of overhead and underground cables, arc lamp disconnecting switches and subway junction boxes. Illustrations of the great electrical plant of the Gary (Ind.) steel mills are given, in which plant these potheads are used throughout. One bulletin illustrates the pipe cap which serves the double purpose of a driving head and an electrical connection for ground pipes. A safety line disconnector for high-tension lines is also shown.

SPAULDING & PAYOR COMPANY, 17 State Street, is representing in this country the Plania carbons for enclosed miniature and flaming arcs and is issuing a catalog of such carbons for alternating-current and direct-current circuits with prices. The concern has distributed to its customers a very ingenious and neat fountain pen in pocket case, the pen being made as an exact copy of a Plania carbon. It it difficult to detect the imitation until the cap is taken off the pen, which is a regular stylograph equal to all the emergencies of correspondence—light or otherwise. The same firm is introducing the ingenious Armstrong ozone generator attachable to any electric lamp socket.

MEASURING INSTRUMENT BULLETINS.—The Industrial Instrument Company supplies data on its instruments in the form of engineering bulletins, each bulletin being devoted to a certain line or class of meters, or to those instruments of different classes that group themselves conveniently for a certain industry. This method shares much of the elasticity of loose-leaf catalogs without involving the trouble of their maintenance. It furthermore eliminates the formidable general catalog, only a small part of the contents of which is of interest to the average customers. The engineering bulletin treats one type or class of instruments exhaustively, without including irrelevant matter. The various bulletins published by this company are 8x11 in size and punched for binding together in substantial covers. These covers, or binders, and any bulletins will be sent to engineers interested in instruments upon application to The Industrial Instrument Company, Foxboro, Mass.

Business Notes.

E. F. QUIRKE, of the New York office of the H. W. Johns-Manville Company, who has been representing the office in the South, has resigned.

THE HARRISBURG FOUNDRY & MACHINE WORKS have appointed Mr. F. W. Jackson manager for the Baltimore district with headquarters in the Continental Trust Building. Mr. Jackson has been connected with the engineering and sales departments of the company for a number of years.

MR. JOHN H. BARKER, who has been connected with the sales department of the Northern Electrical Manufacturing Company for the past five years, during three years of which he had charge of the New York office, has associated himself with the Diehl Manufacturing Company, Elizabethport, N. J.

MR. FRED HAAS, purchasing agent for the Inter-State Railways Company, has tendered his resignation, in order to engage in the railway supply business in the same city, handling such supplies as may be essential to the running of street railways. The name of the firm is to be the Atlantic Supply Company.

MR. CLARENCE E. DELAFIELD, sales manager of the Ideal Electric & Manufacturing Company, Mansfield, Ohio, is spending some time in the East for the purpose of enlarging the sales organization of the company in order to handle its rapidly increasing trade in alternating- and direct-current motors and generators.

Q. M. S. CO.—In order to simplify details in connection with correspondence, telephoning, etc., the Quincy, Manchester, Sargent Company, Plainfield, N. J., has deemed it advisable to change its name, and hereafter will operate under the corporate name of "The Q. M. S. Co." This change has been under consideration for some time, one great objection to the old name being the inconvenience and time consumed in pronouncing the full name over the telephone.

Weekly Record of Electrical Patents

UNITED STATES PATENTS ISSUED JUNE 8, 1909.

[Conducted by Wm. F. Bissing, Pat. Law, 2 Rector St., N. Y. City.]

923,839. MEANS FOR CONTROLLING THE SUPPLY OF ELECTRIC CURRENTS; G. Henry, Lennoxville, Que., Can. App. filed Feb. 2, 1907. Automatically opens and closes the circuit by a thermo-expansive wire connected to a lever.

923,851. TROLLEY HANGER; W. H. Kempton, Hartford, Conn. App. filed Feb. 18, 1908. A trolley hanger provided with a slotted supporting strap attached to the cable and having clamping plates to which the trolley wire is to be attached.

923,864. PROCESS FOR THE ELECTRIC DISSOCIATION OF METALS BY THE WET METHOD; A. Levy, Paris, France. App. filed Feb. 3, 1908. For cleaning metal articles electrolytically and coating them by means of an alkaline bath of cyanide of copper.

923,874. RELAY; E. McClintock, St. Paul, Minn. App. filed April 30, 1907. For steam railroads in which a relay has circuit closers actuated by a motor so as to close the circuit for a predetermined period.

923,882. ATTACHMENT FOR TELEPHONES; R. E. Pedigo, Chariton, Ia. App. filed July 13, 1908. Attachments for party lines. Provides a means so that the removal of any of the receivers from the hooks will not interfere with the transmission of signal currents over the line by means of a condenser in series with a telephone receiver and bridging terminals.

923,887. ELECTRICAL ROSETTE; C. D. Platt, Bridgeport, Conn. App. filed Nov. 28, 1908. The rosette has a base with a recess holding terminals having locking springs, engaging with locking projections so constructed as to permit the cap and base to be assembled and separated by a rotary movement of the cap.

923,889. CONDENSER; A. Pruessman, Chicago, Ill. App. filed April 1, 1907. The process of making condensers which consists in rolling the strips of coil and insulating material in an elliptical cylinder pressing in a rectangular mold so as to shorten the longer diameter of the cylinder forming a prism.

923,901. ELECTRIC RAILWAY SIGNAL; W. A. D. Short, Chicago, Ill. App. filed Sept. 6, 1907. The signal blade is operated by an electric motor and clutch controlled by a brake.

923,933. DISTRIBUTING TERMINAL FOR TELEPHONE CABLES; F. J. Beaucond, New Albany, Ind. App. filed Nov. 20, 1907. Supporting bracket, carrying a box for the terminal ends and clamping blocks on the bracket having an adhesive compound for holding the cable.

923,949. ELECTROMAGNETIC SIGNAL-CONTROLLING DEVICE; E. B. Craft, Chicago, Ill. App. filed Sept. 10, 1906. Telephone exchange having a combined line and cut-off relay, with a magnetic extension for the core of the magnet of the relay.

924,603.—Electric Furnace.

923,950. ANTISEPTIC ATTACHMENT FOR TELEPHONE TRANSMITTERS; E. B. Crosby, Lockport, N. Y. App. filed Jan. 11, 1909. Disinfecting appliance in which a pad is supported by its clip in contact with the interior face of the mouthpiece so that it can be wiped around the mouthpiece.

923,962. WIRELESS TELEGRAPHY; R. A. Fessenden, Washington, D. C. App. filed Dec. 31, 1905. For transmitting speech and simultaneously receiving it on the same antenna by means of a commutator adapted to alternately connect the antenna with the receiving and sending devices and having a periodicity above the limits of hearing.

923,963. WIRELESS TELEGRAPHY; R. A. Fessenden, Washington, D. C. App. filed Jan. 9, 1907. An apparatus for generating high-frequency oscillations in which the discharge gap is contained in a medium formed of the gases of the argon and helium group.

923,973. ELECTRIC MOTOR CONTROL; D. C. Jackson, Madison, Wis. App. filed April 14, 1906. For protecting electric motors during starting by means of a plurality of electromagnet solenoid switches controlling the circuits of the motor.

923,993. TELEPHONE EXCHANGE SYSTEM; J. L. McQuarrie, Oak Park, Ill. App. filed Sept. 15, 1906. Operator's keyboard equipment with a signal and key adapted to connect the telephone lock circuit with a connecting circuit and a locking circuit for the signal controlled by the key.

924,020. METHOD OF FORMING DESIGNS BY ELECTRODEPOSITION; F. A. Walter, Rochester, N. Y. App. filed Sept. 28, 1907. Makes a sign by first providing a mold having a base of conducting material and then a matrix from the mold, and then by electroplating on the coating of conducting material and the bottom plate of the mold.

924,030. TELEPHONE RINGER; J. A. Birsfield, Chicago, Ill. App. filed Nov. 20, 1906. A polarized telephone bell in which the armature is formed of a single sheet of metal having a loop clamping a tapper rod.

924,040. ELECTRIC LIGHT BATH APPLIANCE; E. Collins, Chicago, Ill. App. filed March 5, 1908. An arched reflector placed under a blanket and over the body and carrying electric lights.

924,072. MOUTHPIECE FOR TELEPHONE TRANSMITTERS; M. S. Hufschmidt, San Francisco, Cal., and C. F. Wagner, Oakland, Cal. App. filed Nov. 10, 1908. Gives off antiseptic vapors and absorbs a liquid disinfectant by means of a non-porous coating covering the surfaces of the mouthpiece.

924,092. ELECTRIC CUT-OUT; T. E. Murray, New York, N. Y. App. filed April 13, 1908. A fuse plug with locking means for preventing removal of the cover. The base has an internal threaded socket and the fuse plug is threaded to enter the socket.

924,093. ELECTRIC FUSE CASE; T. E. Murray, New York, N. Y. App. filed Sept. 28, 1908. A tubular fuse case formed of a single piece of porcelain in which the fuse is enclosed in pulverized magnesia, etc.

924,095. THERMOSTAT CONTROLLER; J. McCartin, Brooklyn, N. Y. App. filed Jan. 29, 1909. The thermal member consists of a compound metallic bar, with which a pivoted armature engages, controlled by an electromagnet.

924,126. ELECTRICALLY CONTROLLED LOCK; A. Armel and C. M. Legrand, Paris, France. App. filed March 26, 1908. For operating carriage of motor cars, etc., from a distance by means of a push exerted on a spring in the lock. It is controlled by a pushbutton near the driver.

924,130. F. M. Becket, Niagara Falls, N. Y. App. filed Jan. 21, 1909. For making chromium, etc., by using boron as a reducing agent in the smelting.

924,168. WIRELESS SIGNALING SYSTEM; G. Marconi, London, England. App. filed Nov. 27, 1905. A signaling system having an antenna parallel with the surface of the earth and coincident with the line of transmission of the signals, the antenna being grounded at its end nearer the distant station.

924,180. ELECTRIC BELL; W. J. Murray, Leavenworth, Kan. App. filed Sept. 3, 1907. Avoids making a spark by sending the current through different paths alternately without breaking the circuit.

924,195. ELECTRIC POWER HAMMER; W. Scribner, Columbus, Ohio. App. filed Jan. 22, 1908. A solenoid magnet with its coils in sections. The hammer is attached to the coil of the solenoid.

924,227. RAILWAY SIGNAL OPERATING DEVICE; A. S. Hickley, Manasquan, N. J. App. filed April 24, 1908. Utilizes alternating currents by changing them into direct currents through the medium of an electrolytic rectifier, the direct current working the signals without using storage battery.

924,295. ELECTROLIER SWITCH; C. Tomschik, New York, N. Y. App. filed June 26, 1908. Operated by a chain and pulley for giving the circuit controller a step-by-step movement to switch on the lights.

924,403. SIGNAL; D. B. Utt, Newcastle, Ind. App. filed May 12, 1908. An illuminated signal controlled by a train including a semaphore blade. The blade is worked mechanically from the track by the train.

924,463. CONTROLLER OPERATING HANDLE FOR ELECTRIC CARS; E. K. Hofmann, Andover, Mass. App. filed April 8, 1909. A controller shaft with a clamp fitting against the upper end of the shaft so as to prevent removal from the controller shaft by boys tampering with the mechanism.

924,489. SEMAPHORE CONTROLLER; T. F. McAndrews and J. E. Bleibtrey, Waterford, N. Y. App. filed Oct. 19, 1908. A signal operating rod and operating lever; a link having a lost motion connection and a motor for operating the parts, the lost motion giving the motor time to acquire momentum.

924,499. THERMOSTATIC CIRCUIT CONTROLLER; H. F. Rice, Espy, Pa. App. filed July 25, 1908. For protecting vessels against fire, the contact device consisting of a diaphragm and screw pin striking the diaphragm.

924,503. CYLINDRICAL POSITIVE ELECTRODE; E. O. Schneider, Dresden, Germany. App. filed Sept. 1, 1908. Consists of a number of rings parallel with each other and connected by bars.

924,512. TELAUTOGRAPH; G. S. Tiffany, Summit, N. J. App. filed May 16, 1907. A shifting mechanism controlled from a distant instrument to feed the paper and to store up the strip for record.

924,538. TELEGRAPHIC RECEIVING TAPE; P. B. Delany, South Orange, N. J. App. filed March 23, 1904. A chemical tape having projections in arbitrary sequence formed by depressing the face of the tape.

924,560. WIRELESS SIGNALING SYSTEM; G. Marconi, London, Eng. App. filed Aug. 9, 1906. An antenna having two parts parallel with the surface of the earth, the length being substantially one quarter of a wave length and the antenna being in a vertical plane passing through the distant station.

924,573. BATTERY AND HOLDER THEREFOR; G. L. Patterson, New York, N. Y. App. filed May 26, 1908. For mechanically and electrically connecting a battery to a holder by means of a socket and two terminal cases attached thereto, the cell fitting the socket and having electrodes for electrical connection with the socket terminals.

924,574. BATTERY AND HOLDER; G. L. Patterson, New York, N. Y. App. filed May 26, 1908. The holder includes a socket with two terminal pieces, one receiving the cell and the other extending laterally to constitute the opposite terminal of an adjacent socket.

924,575. BATTERY; G. L. Patterson, New York, N. Y., and G. H. Hopper, Brookiyn, N. Y. App. filed Oct. 16, 1908. A battery of the socket type convertible into the binding-post type, having a cupped member forming one electrode.

924,576. BATTERY BOX TERMINAL CONNECTION; G. L. Patterson, New York, N. Y. App. filed Dec. 1, 1908. A box for shielding the batteries in automobiles and permitting the group of batteries to be removed bodily from the box.

924,577. BATTERY BOX; G. L. Patterson, New York, N. Y. App. filed Dec. 1, 1908. A separate cell backet for the batteries removably carried by the box and fitting in the interior of the box.

924,603. ELECTRIC FURNACE; Louis D. Fransworth, Palo Alto, Cal., and Max J. Bartell, San Francisco, Cal. App. filed April 3, 1908. The current is distributed vertically in the crucible, thereby regulating it by changing the height of the metal level. The inner ends of the electrode are wedge shaped.

924,609. ROTARY SNAP SWITCH; G. W. Goodridge, Bridgeport, Conn. App. filed Jan. 3, 1908. A simple binding post for rotary snap switches, made of sheet metal secured to the switch.

924,616. DRIVING MECHANISM FOR CASH REGISTERS; C. F. Kettering, Dayton, Ohio. App. filed June 11, 1906. Comprises an electric motor connected with the cash register, the motor circuit being controlled by the keys of the register.